NIOSH EXTRAMURAL RESEARCH AND TRAINING PROGRAM

ANNUAL REPORT OF FISCAL YEAR 2015

Prepared by the Office of Extramural Programs | National Institute for Occupational Safety and Health

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
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DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

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FOREWORD

I am pleased to deliver the FY2015 annual report of activity of the extramural research and training program of NIOSH. These data reflect the exceptional work of the extramural community of researchers supported by NIOSH and the Office of Extramural Programs.

This report details the investment NIOSH made during the fiscal year to our multidisciplinary centers, investigator-initiated research projects, and cooperative research agreements. Funding is also described for our training project grants, state surveillance programs, small business innovation research, and global health initiatives. This report does not include data on the grants program associated with the World Trade Center Health Program.

An analysis of funding and activity is provided by the NORA program area along with a review of integrated research activity for each of the NORA sector strategic goals. Hyperlinks to the NIOSH website have been embedded throughout the report, providing instant access to additional relevant data and information. The appendices provide additional data on the highlights of FY2015 and include a summary of the public health relevance and impact of our extramural portfolio.

I would like to acknowledge the work of the scientific program officials of the Office of Extramural Programs in compiling this report, along with the contributions of student interns from Project IMHOTEP, an 11-week summer internship supported by a cooperative agreement between Morehouse College's Public Health Sciences Institute and the Centers for Disease Control and Prevention that is designed to increase the number of college students entering into graduate programs, and to encourage careers in public health.

John Howard, MD
Director, National Institute for
Occupational Safety and Health
Centers for Disease Control and Prevention

EXECUTIVE SUMMARY

In FY2015, NIOSH awarded $96,774,267 in extramural funding, a decrease of $933,859 from the previous year. A total of 183 awards were made during the fiscal year, and the success rate for investigator-initiated research grants was 12%.

Multidisciplinary centers received a total of $52,779,439 (54%) and 33 awards in the following program areas:

- $26.9 million for 18 Education and Research Centers (ERCs)
- $15.2 million for 10 Agriculture Safety and Health Centers (Ag Centers)
- $5.8 million for 1 CPWR – The Center for Construction Research and Training
- $4.9 million for 4 Centers of Excellence to Promote a Healthier Workforce

Investigator-initiated and career development research received a total of $27,019,595 (28%) and 82 awards. Cooperative research agreements made up $10,687,931 (11%) of the extramural portfolio, with 38 awards. Specialty training programs received a total of $5,612,480 (6%) with 28 awards and $674,822 (1%) for two small business innovation research projects.

Funding for global health initiatives included a cooperative agreement with the World Health Organization (WHO) for $249,993 to support the Global Plan of Action on Workers' Health to strengthen the capacities of national health systems to respond to the specific health needs of workers.

NIOSH continued its long-standing support of global occupational health research and training through cosponsorship of the NIH Fogarty International Center Global Environmental and Occupational Health Hubs to support the development of institutions in low- or middle-income countries that serve as regional hubs for collaborative research and training around high priority environmental and occupational health threats.

In FY2015, NIOSH extramural researchers reported 472 peer-reviewed publications in 234 journals. The largest number of publications resulted from investigator-initiated R01 research (150), followed by ERCs (140). The journal most frequently published in by NIOSH researchers was Occupational and Environmental Medicine.

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LIST OF ABBREVIATIONS

SECTOR PROGRAMS

ALL	All Sectors or Multiple Sectors
AgFF	Agriculture, Forestry, and Fishing
CON	Construction
HSA	Healthcare and Social Assistance
MNF	Manufacturing
MIN	Mining
MIO	Oil and Gas Extraction
SPS	Public Safety
SRV	Services
WRT	Wholesale and Retail Trade
TWU	Transportation, Warehousing and Utilities

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I. NIOSH EXTRAMURAL RESEARCH AND TRAINING PORTFOLIO

The NIOSH Extramural Research and Training Programs represent a diverse portfolio of multidisciplinary research and training centers, investigator-initiated research, mentored research scientist development awards, training project grants, and small business innovation research projects in occupational safety and health. State surveillance programs and global occupational health initiatives complement the breadth and depth of extramural research and training at NIOSH. A description of these programs can be found at the Research and Training Portfolio webpage. Extramural funding opportunity announcements are published in the NIH Guide for Grants and Contracts, and are also available under "Funding Opportunities" on the NIOSH Extramural Research and Training Programs webpage. Please see Appendix 1 for a list of all the NIOSH Funding Opportunity Announcements published in FY2015.

NATIONAL OCCUPATIONAL RESEARCH AGENDA

The extramural research portfolio is organized into priority areas in occupational safety and health as described in the National Occupational Research Agenda (NORA), a stakeholder-driven research agenda designed to stimulate research and address the most pressing needs in workplace safety and health in the United States. Unveiled in 1996, NORA involves diverse parties collaborating with NIOSH to identify the most critical issues in workplace safety and health. These partners work together to develop goals and objectives to address specific, recognized needs through innovative research and subsequent research to practice (r2p) actions. This r2p focus is integrated into the breadth of NIOSH funded research activities. In order to achieve this, NIOSH works with partners to focus research on developing effective products, translating research findings into practice, targeting dissemination efforts, and evaluating the effectiveness of these efforts in improving worker safety and health. More information on the NIOSH r2p program can be obtained via the Research to Practice webpage.

In FY2015, the NIOSH program portfolio was organized around the Second Decade of NORA structure, which consists of 10 NORA sector programs and 24 cross-sector programs and includes adverse health and non-health outcomes, statutory programs, and global efforts. Each program area sets priorities for NIOSH work in the sector, monitors NIOSH-funded projects related to its sector, and encourages new NIOSH projects to address sector priorities. More information about these program areas and research priorities can be found by clicking on the program names in Table 1.

NIOSH PROGRAM AREAS

Table 1. NIOSH Program Areas

NIOSH Sector Program Areas	
Agriculture, Forestry, and Fishing	Oil and Gas Extraction
Construction	Public Safety
Healthcare and Social Assistance	Services
Manufacturing	Transportation, Warehousing and Utilities
Mining	Wholesale and Retail Trade
NIOSH Health Outcome Cross-sector Program Areas	
Cancer, Reproductive and Cardiovascular Diseases	Respiratory Diseases
Hearing Loss Prevention	Traumatic Injury
Immune and Dermal Diseases	Work Organizations and Stress Disorders
Musculoskeletal Disorders	
NIOSH Non-health Outcome Cross-sector Program Areas	
Authoritative Recommendations	Occupational Health Disparities
Communications and Information Dissemination	Personal Protective Technology
Economics	Prevention Through Design
Emergency Preparedness and Response	Radiation Dose Reconstruction
Engineering Controls	Small Business Assistance and Outreach
Exposure Assessment	Surveillance
Global Collaborations	*Total Worker Health*®
Health Hazard Evaluation	Training Grants
Nanotechnology	

II. NIOSH EXTRAMURAL RESEARCH ACTIVITY

FUNDING DISTRIBUTION FY2015

In FY2015, NIOSH awarded $96,774,267 in extramural funding. The distribution of awards by type of activity is shown in Figure 1. Fifty-four percent (54%) of the extramural funding went to multidisciplinary centers, followed by 28% for investigator-initiated and career development research grants. Other cooperative research agreements made up 11% of the FY2015 portfolio, followed by specialty training programs (6%), and small business innovation research projects (1%).

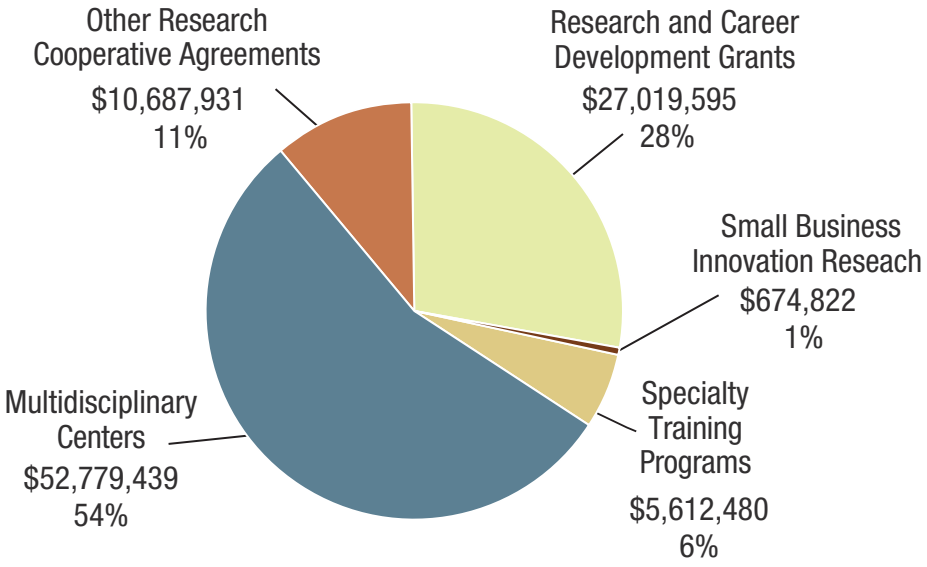


Figure 1. NIOSH extramural grant distribution, FY2015

In FY2015, NIOSH made a total of 183 awards. Of these, 73 (40%) were for new projects while 110 (60%) were continuing awards. A summary of all the NIOSH extramural awards for FY2015 is shown in Table 2. Of the 183 awards made, 33 (18%) were for multidisciplinary research and training centers, which include Education and Research Centers, Agriculture Safety and Health Centers (Ag Centers), CPWR – The Center for Construction Research and Training, and Centers of Excellence to Promote a Healthier Workforce; 82 (45%) for investigator-initiated research and career development; 38 (21%) for cooperative research agreements; 28 (15%) for training program grants; and 2 (1%) for small business innovation research. A searchable listing of all active awards funded by NIOSH is available on the OEP webpages.

SUMMARY OF ALL AWARDS BY TYPE OF FUNDING

Table 2. Summary of all awards by type of funding in FY2015

Award Category	Award Mechanism	Number of Awards	Funding
Multidisciplinary Centers		33	$52,779,439
Education and Research Centers	Training Grant (T42)	18	$26,949,959
Agriculture Safety and Health Centers	Cooperative Research Agreement (U54)	10	$15,191,482
National Center for Construction Research and Training	Cooperative Research Agreement (U60)	1	$5,750,000
Centers of Excellence to Promote a Healthier Workforce	Cooperative Research Agreement (U19)	4	$4,887,998
Investigator-initiated Research Grants		82	$27,019,595
Research Grants	Investigator-initiated (R01, R03, R21,R13)	72	$25,944,718
Career Developmental Research	Mentored Career Scientist (K01)	10	$1,074,877
Cooperative Research Agreements		38	$10,687,931
Surveillance	Cooperative Research Agreement (U60)	26	$6,755,989
Workers Compensation Surveillance	Cooperative Research Agreement (U60)	2	$399,589
Agricultural, Forestry and Fishing Safety and Health	Cooperative Research Agreement (U01)	8	$2,198,026
Mesothelioma Tissue Bank	Cooperative Research Agreement (U24)	1	$1,084,334
World Health Organization	Cooperative Research Agreement (E11)	1	$249,993
Specialty Training Programs		28	$5,612,480
Training Project Grants	T01 and T03	25	$3,997,985
Miner Safety and Health Training Program	Cooperative Research Agreement (U60)	3	$1,614,495
Small Business Innovation Research		2	$674,822
Small Business Innovation Research	Phase II (R44)	2	$674,822
Total Extramural Funding		183	$96,774,267

EXTRAMURAL RESEARCH PORTFOLIO FY2015

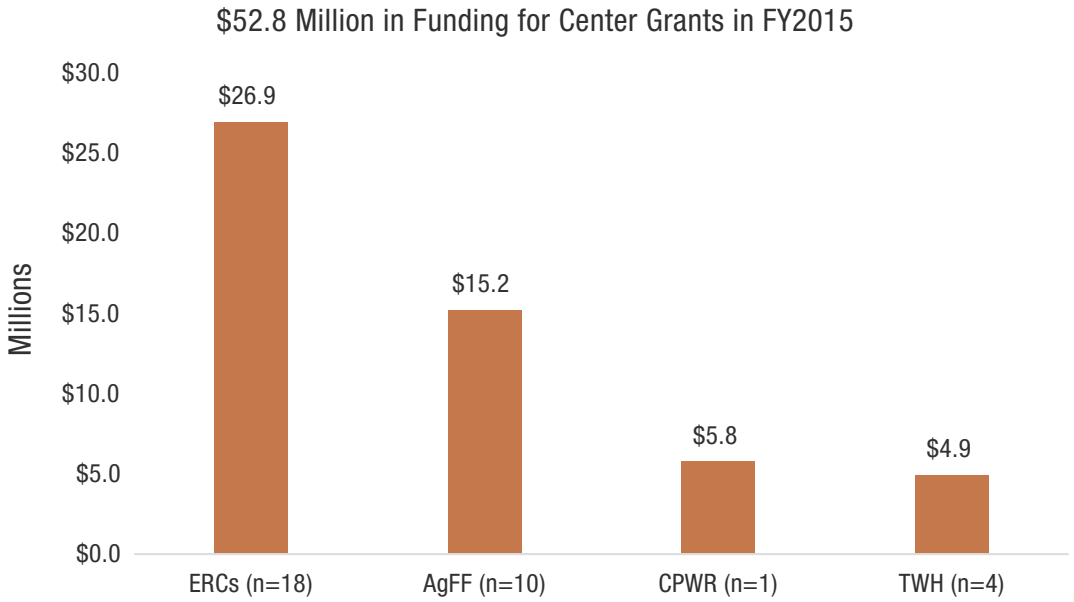
Multidisciplinary Centers

NIOSH funds targeted research and outreach activities through multidisciplinary centers, with a focus on high-risk industries that contribute disproportionately to occupational injury and illness in the United States. These centers are funded through a variety of grant mechanisms, including cooperative research agreements and center training grants. The Agriculture Safety and Health Centers (Ag Centers) and CPWR – The Center for Construction Research and Training provide critical research and training into the multiple safety and health hazards in agriculture and construction.

Centers of Excellence to Promote a Healthier Workforce provide a multidisciplinary and multifactorial approach to worker health and well-being. The activities of these centers reflect a broader understanding of the critical relationship between work, health, and productivity.

Multidisciplinary education and research activities are carried out through a national network of Education and Research Centers. ERCs are university-based centers that provide graduate training in the core and allied fields of occupational safety and health. In addition to degree training, ERCs provide continuing education and outreach to the occupational safety and health community throughout the federal health region they serve.

Approximately $52.8 million was awarded to 33 multidisciplinary centers in FY2015. A total of 18 ERCs received $26.9 million, while $15.2 million was awarded to 10 Ag Centers and $5.8 million to CPWR – The Center for Construction Research and Training, along with $4.9 million that funded four Centers of Excellence to Promote a Healthier Workforce (see Figure 2). A full description of each of these center portfolios, including a listing of individual center grants, is provided in Appendix 2.



ERCs = Education and Research Centers; AgFF = Agriculture, Forestry, and Fishing; CPWR = National Center for Construction Research and Training; TWH= Centers of Excellence to Promote a Healthier Workforce

Figure 2. Multidisciplinary center awards, FY2015

Investigator-initiated Research

Research Grants

The goal of the NIOSH extramural research program is to support relevant and high-quality scientific investigations that will help reduce occupational injuries, illnesses and fatalities. NIOSH responds to that goal by funding investigator-initiated research. These diverse awards include funding for large occupational safety and health research projects (R01), small occupational safety and health research grants (R03), and exploratory occupational safety and health research grants (R21). The extramural research portfolio includes research scientist career development awards (K01), which provide mentored training for the next generation of occupational safety and health scientists. These highly competitive K01 awards provide up to 3 years of funding and a scientific focus designed to develop the skills and productivity of new career scientists. A total of approximately $27 million was awarded to new and continuing research projects and mentored scientist grants in FY2015 (see Table 3). A description of investigator-initiated research outputs is provided in Appendix 2.

Conference Grants

NIOSH recognizes the value of supporting high-quality scientific meetings that are relevant to the mission of preventing injuries, illnesses, and fatalities caused by hazards in the workplace. Conference grants are awarded under a research grant mechanism (R13), and in FY2015, NIOSH funded three conference grants (see Table 3).

Table 3. Investigator-initiated research funding, FY2015

Type of Grant	New Awards	New Funding	Continuing Awards	Continuing Funding	Total Funding
R01	13	$6,104,772	35	$16,304,532	$22,409,304
R21	4	$ 864,488	10	$ 2,098,116	$2,962,604
K01	5	$ 539,952	5	$ 534,925	$1,074,877
R03	3	$ 221,404	4	$ 291,406	$512,810
R13	2	$ 40,000	1	$20,000	$60,000
Total	27	$7,770,616	55	$19,248,979	$27,019,595

Cooperative Agreements

Cooperative agreements give NIOSH the ability to arrange collaborative surveillance and research opportunities with state health departments, universities, labor unions, and nonprofit organizations. NIOSH provides funding for a broad array of cooperative agreements to develop knowledge for preventing occupational diseases and injury.

Unlike grants, which are conducted independently of the sponsoring agency, cooperative agreements bring together the expertise of federal and nonfederal researchers to accomplish public health efforts that would not otherwise occur. In order for a cooperative agreement to be awarded, there must be a clear need for programmatic staff involvement during performance of a proposed project. An evaluation is made to determine that the cooperative agreement is of sufficient priority to warrant the commitment of staff resources required for a collaborative effort during the term of the cooperative agreement award.

Cooperative research agreements funded in FY2015 totaled $10.7 million and included long-standing state surveillance programs and new funding for workers' compensation surveillance, along with AgFF funding to support forestry safety research, the Mesothelioma National Tissue Bank and support for the World Health Organization's Global Health Program. Figure 3 shows the distribution of funding and number of cooperative research agreements.

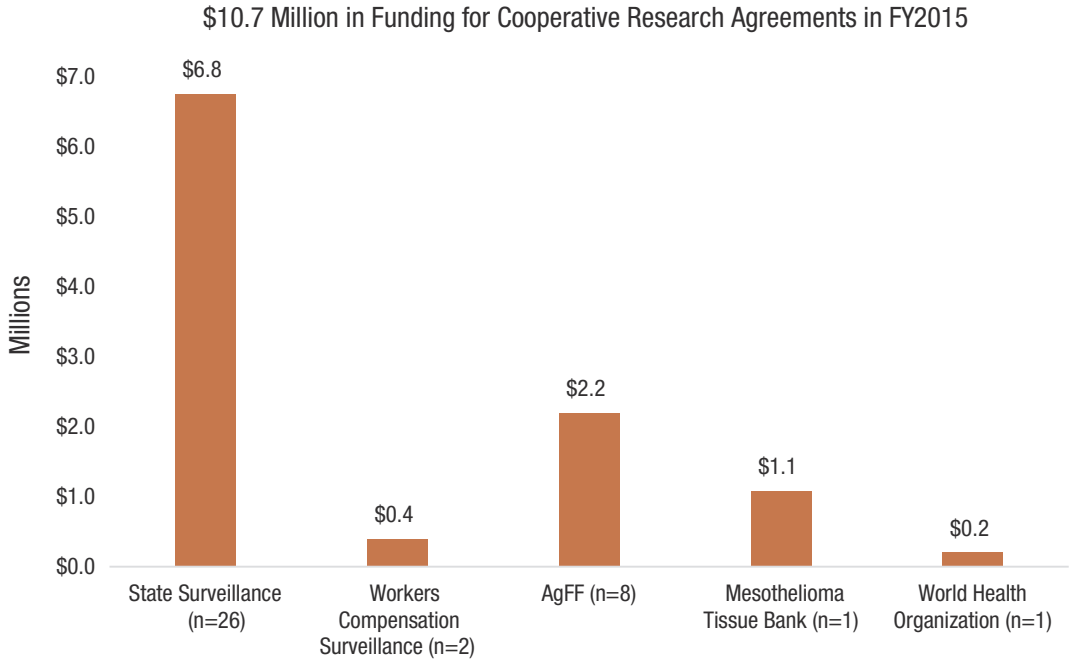


Figure 3. Cooperative agreements, FY2015

State Surveillance Program

The state surveillance program supports capacity development among states to conduct surveillance of occupational injuries, illnesses, and fatalities, and it helps expand the role of states in conducting in-depth surveillance and follow-up through investigations and interventions. In FY2015, the state surveillance portfolio grew from 23 to 26 states. These NIOSH-sponsored programs contribute to a national occupational health surveillance strategy for identifying workplace injury and illness and opportunities for research and intervention. Please see the State Surveillance Portfolio Annual Performance Reports for more information on these state-based initiatives. See Table 2 for the total number and funding for all state surveillance awards (new and continuing) for FY2015.

Workers' Compensation Surveillance

FY2015 marked the first year of the Workers' Compensation Surveillance Cooperative Agreement, which aims to compile, analyze, and disseminate workers' compensation (WC) data. The overall goal of this collaboration is to prevent occupational injuries, illnesses, and fatalities within states and across the nation. Through these agreements, state health and WC agencies, along with businesses and other eligible organizations, are provided resources allowing them to start or expand state-based WC surveillance and interventions efforts. States will have the opportunity to use their data to conduct comparable surveillance and identify trends and emerging issues, along with high-risk occupations, industries, and worker populations. In FY2015, two new awards were made to the California Public Health Institute and Massachusetts Department of Public Health.

Agriculture, Forestry, and Fishing

The NIOSH Office of Agriculture Safety and Health began this research cooperative agreement program in FY2014 to accomplish the following:

- Further the understanding of risks and conditions associated with forestry- or logging-related occupational injuries, illnesses, and fatalities.
- Explore methods for reducing risks and for preventing or minimizing exposure to hazardous conditions in these work environments.
- Translate significant scientific findings into prevention practices and products that will effectively reduce work-related injuries, illnesses, and fatalities in this area.

In addition, the cooperative agreement program aims to enhance knowledge about the effectiveness of existing interventions and the best ways to disseminate, diffuse, and translate proven interventions to benefit workers in this sector—in particular the ability to address the unique needs of vulnerable workers.

Mesothelioma National Tissue Bank

The purpose of the Mesothelioma National Tissue Bank is to accelerate translational research by providing the scientific community with high quality data and biospecimen collection for mesothelioma. This will be a resource giving researchers access to de-identified clinical data associated with a multitude of biospecimens and will support scientific discovery, improve detection, and enable the development of effective treatment for mesothelioma. By supporting

research studies that address the complex mechanisms and biological changes associated with mesothelioma and its disease progression, the Mesothelioma National Tissue Bank may ultimately help improve the overall quality of life of current and former workers diagnosed with and treated for malignant mesothelioma.

World Health Organization

NIOSH recognizes the need for global partnerships and participation in accomplishing its mission of providing national and world leadership to prevent work-related injuries, illnesses and fatalities by providing funding to support global occupational safety and health initiatives through long-standing collaborations with the World Health Organization (WHO).

NIOSH has provided a leadership role to the WHO Collaborating Centres in Occupational Health since 1976, and has been involved in program planning, collaborative research, training, management, and interaction with WHO's Program on Workers' Health.

Additional support of global health activities included cosponsorship of the National Institutes of Health (NIH) Fogarty International Center Global Environmental and Occupational Health (GEOHealth) program. This interagency agreement has supported dozens of research training grants across the globe designed to prepare the next generation of scientists, researchers, and practitioners to deal effectively with the increasing burden of occupational injury and illness around the world. Current funding supports the development of institutions in the low- or middle-income countries that serve as regional hubs for collaborative research, data management, training, curriculum and outreach, and policy development around high priority local, national, and regional environmental and occupational health threats. More information about the global health collaboration with NIH and other partners can be found at the Global Environmental and Occupational Health (GEOHealth) webpage.

Specialty Training Programs

In addition to the Education and Research Centers (ERCs) described under "Multidisciplinary Centers" above, NIOSH supports professional training in occupational safety and health in single disciplines through Training Project Grants (TPGs). The majority of TPGs are academic training programs that support undergraduate and graduate training. These programs complement the national network of graduate training provided by ERCs, and they are located throughout the United States.

NIOSH funds a unique Training Project Grant—the Emergency Responder Training Program—through the International Association of Fire Fighters. This grant supports a comprehensive, nationwide hazardous substance training program for fire fighters, paramedics, and other emergency responders across the United States.

The Miner Safety and Health Training Program–Western United States cooperative agreement connects the mining community with mining-relevant information, resources, and methods that increase the capacity and efficacy of safety training for western states' miners. These services and activities are provided by the Western Mining Safety and Health Training Resource Center at the University of Arizona, along with the Energy, Mining and Construction Industry Safety Program at the Colorado School of Mines and the University of Texas at Arlington Division for Enterprise Development.

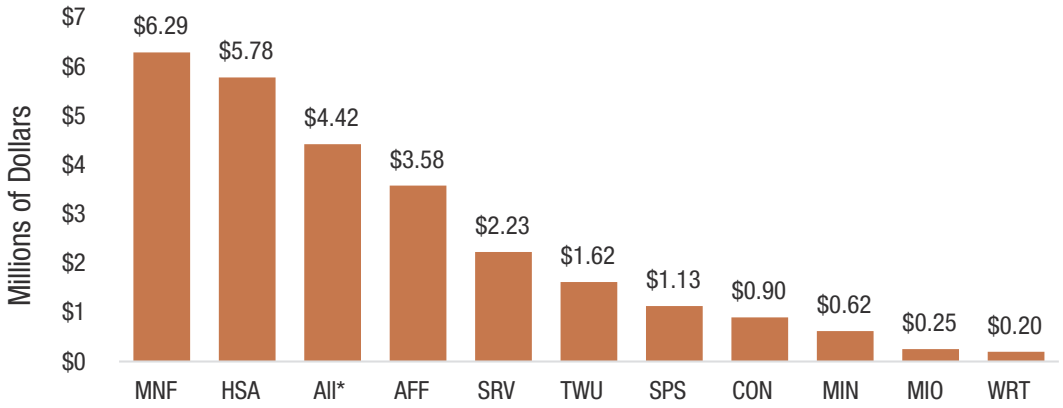
The number and funding for all specialty-training grants (new and continuing) awarded in FY2015 are presented in Table 2.

Small Business Innovation Research

The Small Business Innovation Research (SBIR) program stimulates technological innovation in the private sector and strengthens the role of small business in meeting federal research needs or the private sector's own research and development needs by increasing the commercial application of federally supported research results. The NIOSH SBIR program funds early stage small businesses that are seeking to commercialize innovative technologies for occupational safety and health. This competitive program helps small businesses participate in federal research and development, develop life-saving technologies, create jobs, and improve the return on investment from federally funded research for economic and social benefits to the nation. NIOSH issues solicitations for Phase I and Phase II research proposals from science and technology-based firms. Phase II proposals are limited to small businesses that have successfully completed their Phase I projects. Awards and funding for all FY2015 SBIR grants are presented in Table 2.

EXTRAMURAL RESEARCH ACTIVITY BY NIOSH PROGRAM AREA

The NIOSH program portfolio is organized around the Second Decade of NORA sector structure. Extramural research activity in FY2015 was distributed across all the NIOSH sector program areas. Figure 4 shows the distribution of funding for investigator-initiated research and career development research across NORA sectors in FY2015. Most FY2015 funding was awarded to projects in the Manufacturing Sector, followed by Healthcare and Social Assistance and All Sectors. (Figure 4).



*Includes projects that contribute to advancing all or most of the NIOSH sector programs and includes public health activities tools that cut across NORA industry sectors.

Figure 4. Research funding by sector program, FY2015

SUCCESS RATES FOR RESEARCH PROJECT GRANTS IN FY2007–FY2015

The success rate is the percentage of reviewed applications that receive funding on a fiscal year basis, and it is one of the measures of the viability of the research grants program. The success rates for new awards are calculated for the investigator-initiated research only, which includes the R01, R03, and R21 grant mechanisms.

In FY2015, 20 new research awards (R01, R03, and R21 combined) were given out of 165 new applications (Figure 5), for an overall success rate of 12%. The number of new applications in FY2015 increased from 154 in FY2014 to 165 in FY2015. The overall success rate generally remained stable over the past 8 years, but decreased in FY2015 to its lowest percentage during this period. The increase in new applications in FY2015 resulted in a decline in the overall success rate to 12%. For the FY2007–FY2015 period, the mean annual number of applications was 172, the mean number of awards was 31, and the mean annual success rate was 18%.

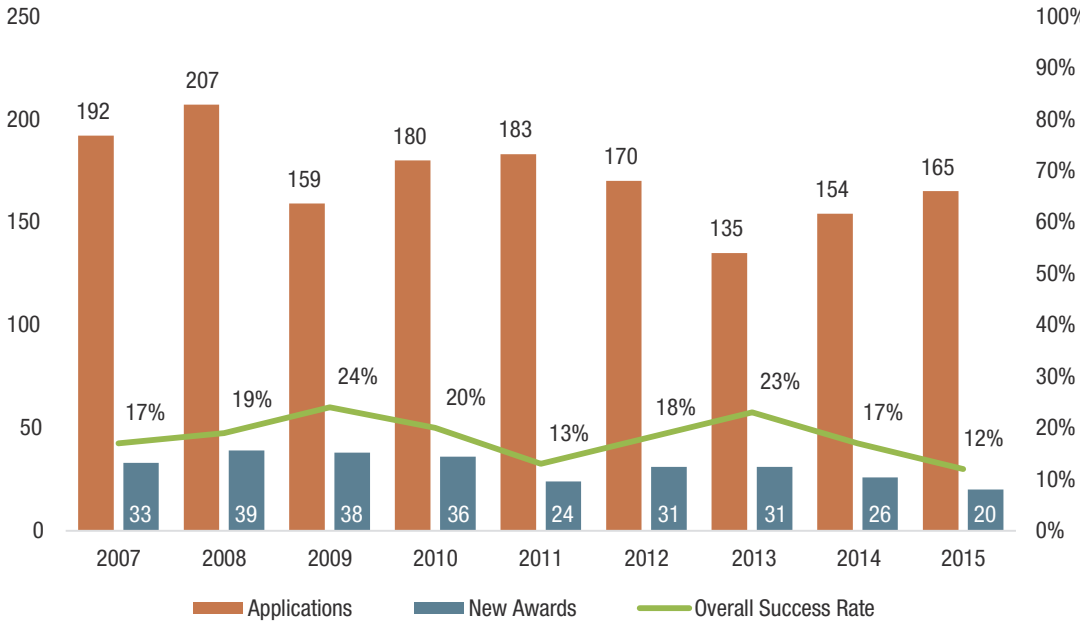


Figure 5. Overall success rates for research project grants (R01, R03, and R21), FY2007–FY2015

R01 Success Rates

Figure 6 shows the success rates for R01 applications from FY2007 to FY2015. The success rate over time has remained somewhat stable, with a high of 28% in FY2010 and a low of 13% in FY2012. However, while the number of applications declined from 135 in FY2007 to 58 in FY2014, this figure rose to 70 in FY2015. There has also been a decline in the number of new R01 awards, from a high of 29 new awards in FY2008 to a low of 9 awards in FY2012. New awards have increased slightly from FY2012.

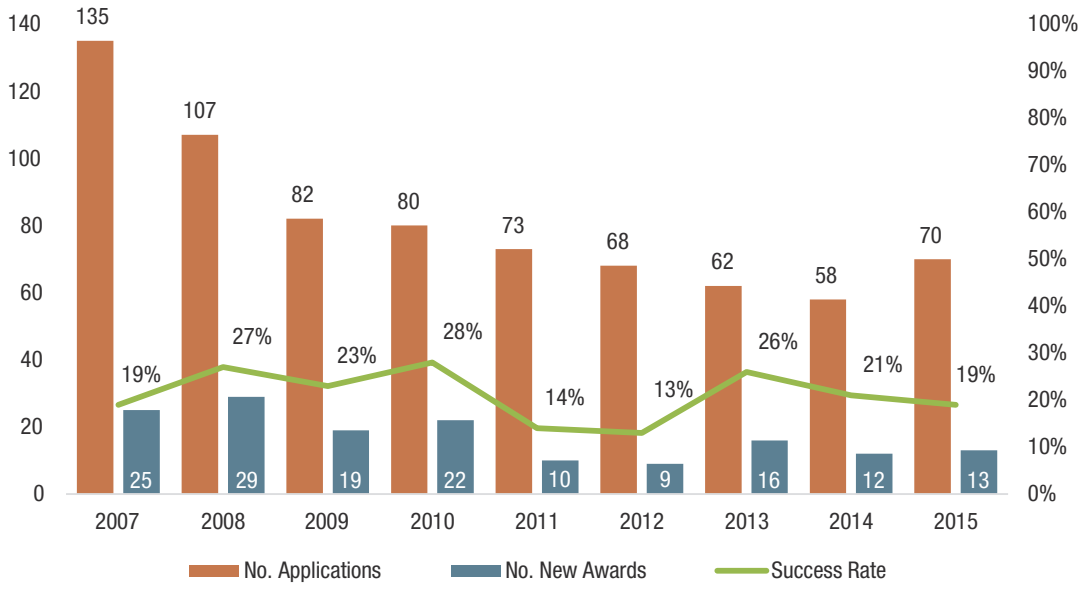


Figure 6. Success rates for R01 applications, FY2007–FY2015

R03 Success Rates

Figure 7 shows the number of R03 applications and new awards made annually from FY2007 to FY2015. Except for a sharp increase in the success rates to 30% in 2009 (most likely due to the decrease in applications that year) overall rates have remained stable from FY2007 through FY2015.

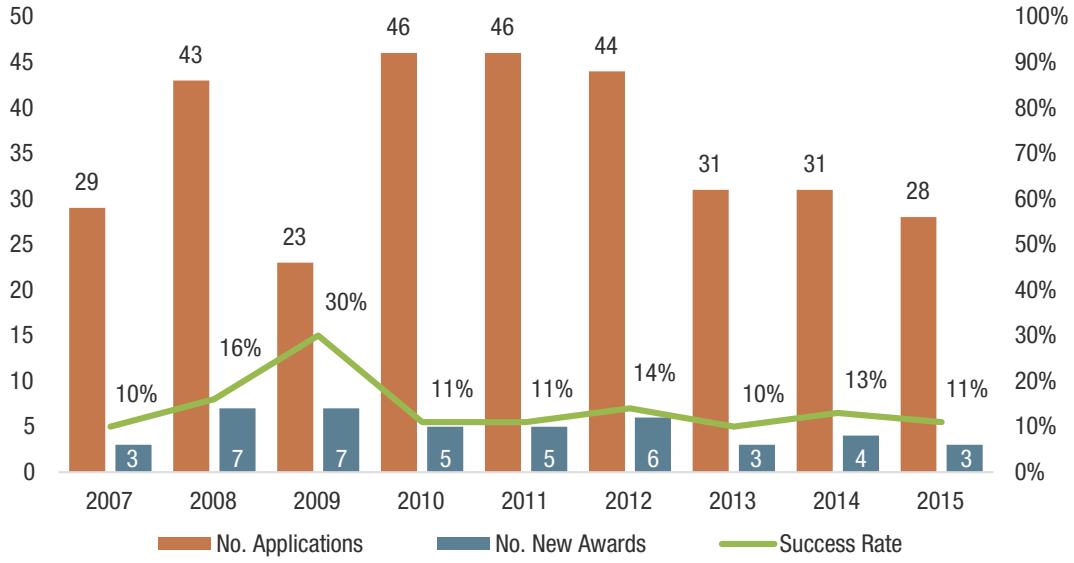


Figure 7. Success rates for R03 applications, FY2007–FY2015

R21 Success Rates

Figure 8 shows the number of R21 applications and new awards made annually from FY2007 to FY2015. The number of R21 applications increased substantially over this time, reaching a high of 67 applications in FY2015. The number of new awards in FY2015 decreased to its lowest point since FY2008 although the trend has remained somewhat stable since FY2009, with a peak of 16 new awards in FY2012.

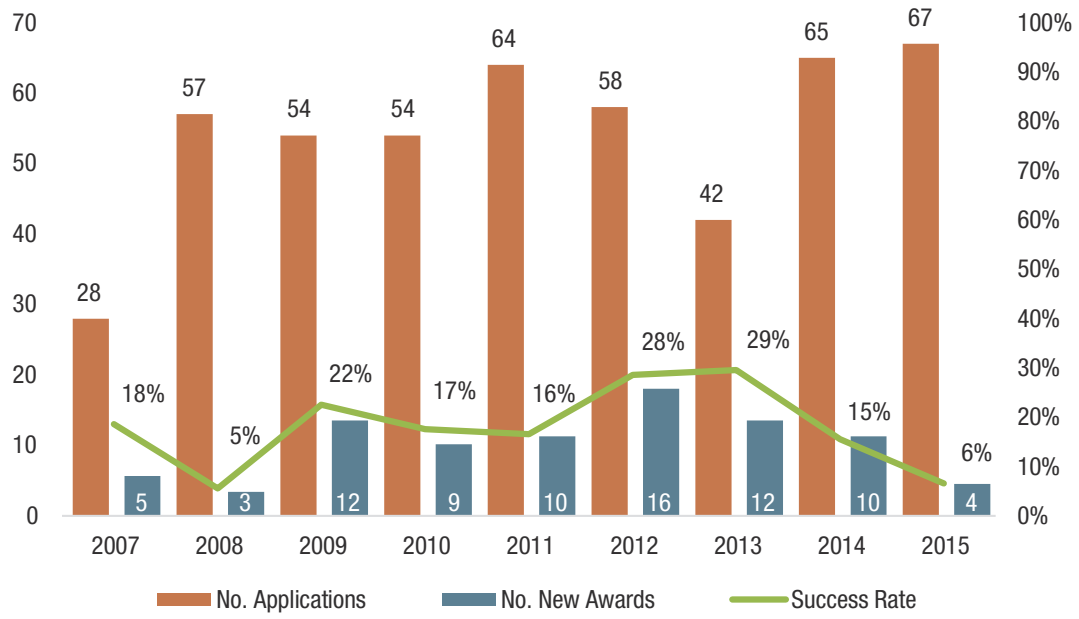


Figure 8. Success rates for R21 applications, FY2007–FY2015

III. RESEARCH INTEGRATION IN FY2015

Research integration at NIOSH is an effort to strategically align and improve research productivity through coordination, cooperation, and collaboration across intramural and extramural programs. One measure of integrated research programs is the extent to which sector program goals are addressed by intramural and extramural research. NIOSH conducts an annual assessment of the number of intramural and extramural projects that address common strategic goals of the NORA sector programs. A full listing and description of each sector's strategic plan and agenda can be found on the NORA homepage on the NIOSH website.

Extramural researchers addressed the greatest number of goals in CON, followed by AFF, MNF, and SPS.

94% of all strategic goals were addressed in FY2015. Extramural researchers addressed **50%** of all strategic goals.

The following figure identifies the 10 sectors that represent the major areas of the US economy. NIOSH sector programs have identified strategic goals to address the most pressing occupational safety and health issues workers face. Intramural and extramural researchers address these goals through research, service, and outreach activities.

Figure 9 presents a graphic representation of the number of strategic goals by sector and the number of goals that were addressed by intramural researchers, extramural researchers, or both. Figure 9 also indicates which goals were not addressed or were inactive during FY2015. In FY2015, a total of 101 of the 108 (94%) NORA strategic goals were addressed by research projects, in particular intramural studies. Extramural projects addressed 54 (50%) strategic goals. The greatest number of goals addressed by extramural research were in Construction (CON), followed by Agriculture, Forestry, and Fishing (AFF), Manufacturing (MNF), and Public Safety (SPS). All strategic goals were addressed by both intramural and extramural research in the AFF, and Transportation, Warehousing and Utilities (TWU) sectors.

Research integration was most evident in the AFF and TWU sectors where intramural and extramural researchers addressed all strategic goals in these two sectors.

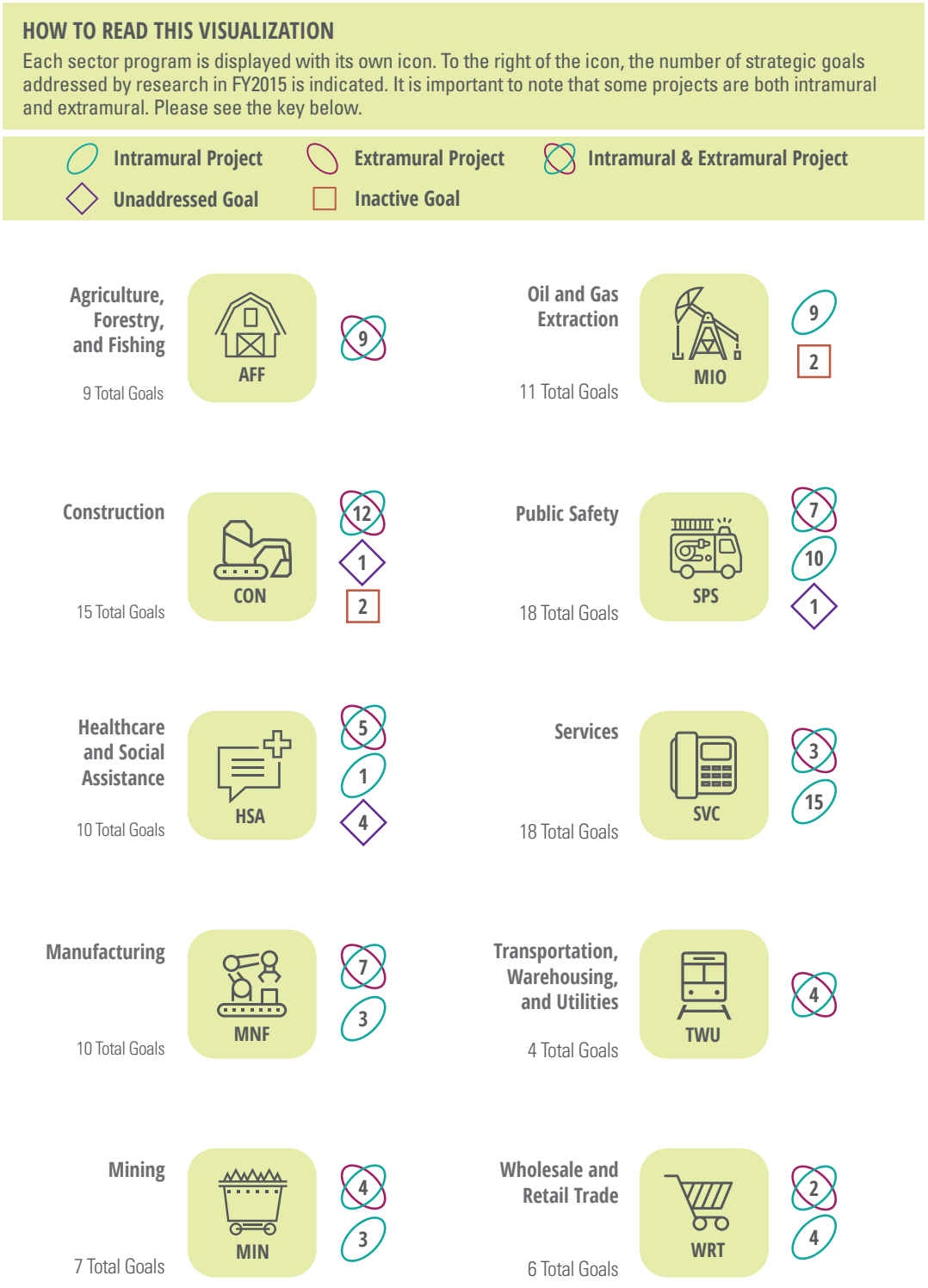


Figure 9. Integration of NIOSH Research Goals by Sector, FY2015

INTEGRATED RESEARCH ACTIVITY BY SECTOR STRATEGIC GOALS, FY2015

In order to better characterize NIOSH-funded research in FY2015, a review was conducted of the strategic goals addressed by extramural and intramural projects by industry sectors. The following tables identify the specific NORA sector strategic goals that were addressed by extramural and intramural research projects. A description of each sector's strategic goals can be found on the NORA webpage.

Agriculture, Forestry, and Fishing

Table 4 displays the strategic goals addressed by extramural and intramural research projects in the Agriculture, Forestry, and Fishing Sector in FY2015. All nine strategic goals for this sector were addressed by both intramural and extramural research projects. The strategic goal most frequently addressed for extramural projects (n=32) and for all research (n=59) was SG1 (Surveillance). Intramural research most frequently addressed SG5 (Agricultural Health).

Table 4. Agriculture, Forestry, and Fishing research projects by strategic goal, FY2015

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Surveillance	32	27
SG2: Vulnerable Workers	15	25
SG3: Outreach and Partnerships	11	14
SG4: Agricultural Safety	11	7
SG5: Agricultural Health	19	31
SG6: Forestry Injuries	2	6
SG7: Forestry Illness/Disease	2	10
SG8: Commercial Fishing Injuries	3	7
SG9: Commercial Fishing Illness/Disease	2	9

Construction

Table 5 displays the strategic goals addressed by extramural and intramural research projects in the Construction Sector in FY2015. Twelve out of 13 active strategic goals for this sector were addressed by both intramural and extramural research projects in FY2015. Two strategic goals (SG2 and SG10) were inactive during this fiscal year. The strategic goal most frequently (n=75) addressed was SG14: Surveillance.

Table 5. Construction research projects by strategic goal, FY2015

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Falls Prevention	3	14
SG2: Electrocution (inactive after FY2011)	0	1
SG3: Struck-by Incidents Prevention	2	9
SG4: Hearing Loss Prevention	2	5
SG5: Silica	2	28
SG6: Welding Fumes	2	19
SG7: Musculoskeletal Disorders	6	9
SG8: Safety and Health Cultures	2	12
SG9: Safety and Health Management	3	10
SG10: Industry and Work Organization (inactive after FY2011)	2	4
SG11: Training and Education	2	7
SG12: Health Disparities	2	20
SG13: Prevention through Design	3	13
SG 14: Surveillance	45	30
SG 15: Engaging Media	0	0

Healthcare and Social Assistance

Table 6 displays the strategic goals addressed by extramural and intramural research projects in the Healthcare and Social Assistance Sector in FY2015. Five out of 10 strategic goals were addressed by both intramural and extramural research projects in FY2015 while SG 8 was supported only by intramural research. Four strategic goals (SG6, SG7, SG9 and SG10) were added in FY2014 and not supported by research projects. SG2: Musculoskeletal Disorders was most frequently addressed by extramural research and the strategic goal most frequently (n=48) addressed by overall projects was SG1: Safety Culture.

Table 6. Healthcare and Social Assistance research projects by strategic goal, FY2015

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Safety Culture	10	38
SG2: Musculoskeletal Disorders	14	9
SG3: Hazardous Drugs and Chemicals	4	36
SG4: Sharp Injuries	2	8
SG5: Infectious Disease	4	39
SG6: Zoonotic Diseases In Veterinary Medicine and Animal Care	0	0
SG7: Injuries In Veterinary Medicine and Animal Care	0	0
SG8: Respiratory Hazards In Veterinary Medicine and Animal Care	0	2
SG9: Reproductive Hazards In Veterinary Medicine and Animal Care	0	0
SG10: Physical Hazards In Veterinary Medicine and Animal Care	0	0

Manufacturing

Table 7 displays the strategic goals addressed by extramural and intramural research projects in the Manufacturing Sector in FY2015. A total of 10 strategic goals for this sector were addressed. Seven were supported by both intramural and extramural research projects in FY2015, while SG1, SG7, and SG10 were only addressed by intramural research projects. The strategic goal most frequently addressed by intramural and extramural projects (n=114) was SG5: Respiratory Diseases.

Table 7. Manufacturing research by strategic goal, FY2015

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Contact with Objects and Equipment	0	14
SG2: Falls	2	4
SG3: Musculoskeletal Disorders	6	23
SG4: Hearing Loss	2	14
SG5: Respiratory Diseases	14	100
SG6: Cancer	7	36
SG7: Vulnerable Populations	0	24
SG8: Small Business	1	17
SG9: Emerging Risks	3	71
SG10: Catastrophic Incidents	0	3

Mining

Table 8 displays the strategic goals addressed by extramural and intramural research projects in the Mining Sector in FY2015. All seven strategic goals for this sector were addressed. Four strategic goals for this sector were addressed by both intramural and extramural research projects in FY2015 while SG2, SG6 and SG7 were supported by intramural research projects. The strategic goal most frequently (n=48) addressed was SG1: Respiratory Diseases.

Table 8. Mining research by strategic goal, FY2015

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Respiratory Diseases	4	44
SG2: Noise-Induced Hearing Loss	0	12
SG3: Musculoskeletal Disorders	3	11
SG4: Traumatic Injuries	3	26
SG5: Disaster Response and Prevention	3	29
SG6: Ground Failure Fatalities and Injuries	0	15
SG7: Interventions with New Technologies	0	17

Oil and Gas Extraction

Table 9 displays the strategic goals addressed by extramural and intramural research projects in the Oil and Gas Extraction Sector in FY2015. Nine active strategic goals were addressed in this sector and supported only by intramural research projects. Two strategic goals (SG5 and SG7) are inactive . The strategic goal most frequently addressed (n = 27) was SG6: Chemical Exposures.

Table 9. Oil and Gas Extraction research by strategic goal, FY2015

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Transportation-Related Injuries and Fatalities	0	13
SG2: Contact Injuries	0	5
SG3: Falls	0	5
SG4: Fires and Explosions	0	3
SG5: Improvement in Workplace Practices, Procedures and Policies	0	0
SG6: Chemical Exposures	0	27
SG07: Develop Industry-Specific Products	0	4
SG8: Fatigue	0	1
SG9: Vulnerable Workers	0	8
SG10: Small Businesses	0	2
SG11: Storage and Transportation	0	1

Public Safety

Table 10 displays the strategic goals addressed by extramural and intramural research projects in the Public Safety Sector in FY2015. Research projects addressed 17 out of 18 strategic goals within this sector. Ten strategic goals (SG3, SG7, SG9, SG10, SG11, SG12, SG13, SG14, SG16, and SG17) were supported by intramural projects, while others were supported by both intramural and extramural research projects. The strategic goal most frequently addressed (n=50) was SG1: Chronic Disease in Fire Fighters.

Table 10. Public Safety research by strategic goal, FY2015

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Chronic Disease in Fire Fighters	2	48
SG2: Structural Firefighting Operations	2	18
SG3: Vehicle-Related Injuries in Fire Fighters	0	11
SG4: Musculoskeletal Disorders	3	3
SG5:Surveillance in Law Enforcement	2	17
SG6: Vehicle-Related Injuries in Law Enforcement	1	13
SG7: Criminal Assaults in Law Enforcement	0	2
SG8: Cardiovascular Disease in Law Enforcement	2	7
SG9: Traumatic Injury in Corrections	0	3
SG10: Infectious Disease in Corrections	0	7
SG11: Occupational Stress in Corrections	0	3
SG12: Vehicle-Related Injuries in EMS	0	6
SG13: Patient- and Equipment-Handling Injuries in EMS	0	2
SG14: Infectious Disease and Hazardous Exposures in EMS	0	21
SG15: Work Organization in EMS	1	4
SG16: Surveillance in EMS	0	8
SG17: Injuries and Illnesses in Wildland Firefighting	0	3
SG18: Health and Safety in Wildland Firefighting	0	0

Services

Table 11 displays the strategic goals addressed by extramural and intramural research projects in the Services Sector in FY2015. All 18 strategic goals for this sector were addressed. Three strategic goals (SG8, SG16, and SG17) were supported by both intramural and extramural research projects, while others were supported only by intramural research. The strategic goal most frequently (n=77) addressed was SG17: Surveillance.

Table 11. Services research strategic goal, FY2015

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Illnesses and Fatal Injuries in Auto Repair	0	4
SG2: Illnesses and Injuries in Building Services	0	14
SG3: Health Disparities in Building Services	0	3
SG4: Illnesses and Injuries in Schools	0	24
SG5: Injuries in Hotel/Motel Industry	0	5
SG6: Illnesses in Hotel/Motel Industry	0	11
SG7: Health Disparities in Hotel/Motel Industry	0	2
SG8: Injuries/Illnesses in Government	1	16
SG9: Traumatic Injuries in Recreation and Entertainment Industries	0	1
SG10: Injuries in Food Services	0	4
SG11: Violence in Food Services	0	1
SG12: Injuries/Illnesses in Telecommunications	0	5
SG13: Traumatic Injuries in Telecommunications	0	1
SG14: Temporary Labor/Contractors/Contingent Workers	0	2
SG15: Injuries in Waste Collection, Disposal, and Recycling Industries	0	2
SG16: Musculoskeletal Disorders	2	6
SG17: Surveillance	44	33
SG18: Injuries/Illnesses in Nail and Hair Salons	0	2

Transportation, Warehousing, and Utilities

Table 12 displays the strategic goals addressed by extramural and intramural research projects in the Transportation, Warehousing, and Utilities Sector in FY2015. All four strategic goals for this sector were addressed and supported by intramural and extramural research. The strategic goal most frequently addressed (n=42) was SG4: Chemical/Biological/Physical Hazards.

Table 12. Transportation, Warehousing, and Utilities research by strategic goal, FY2015

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Traumatic Injuries	2	27
SG2: Musculoskeletal Disorders	4	15
SG3: Health and Wellness Programs	1	17
SG4: Chemical/Biological/Physical Hazards	5	37

Wholesale and Retail Trade

Table 13 displays the strategic goals addressed by extramural and intramural research projects in the Wholesale and Retail Trade Sector in FY2015. All six strategic goals were addressed within this sector. Two strategic goals (SG1 and SG2) were supported by both intramural and extramural research projects while others were supported only by intramural research. SG1: Musculoskeletal Disorders was most frequently addressed (n=5) by extramural research, and the strategic goal most frequently addressed by intramural research (n=20) was SG6: Vulnerable Workers.

Table 13. Wholesale and Retail Trade research by strategic goal, FY2015

Strategic Goal (SG)	Extramural Projects	Intramural Projects
SG1: Musculoskeletal Disorders	5	14
SG2: Traumatic Injuries	1	8
SG3: Violence	0	4
SG4: Vehicle-Related Injuries	0	6
SG5: Small Business Outreach	0	7
SG6: Vulnerable Workers	0	20

IV. FY2015 EXTRAMURAL RESEARCH OUTPUTS AND OUTCOMES

Outputs are the products of research activities. Examples include publications, reports, conference proceedings, presentations/posters, databases, tools, methods, guidelines, recommendations, education and training materials, inventions, and patents. This section describes the outputs and outcomes of NIOSH-funded extramural research during FY2015.

SUMMARY OF PEER-REVIEWED PUBLICATIONS FOR FY2015

Publications by NIOSH-funded extramural researchers were collected from principal investigator reports to NIOSH, the NIH Reporter database, NIOSHTIC-2 database, and PubMed database. From October 1, 2014, to September 30, 2015, there were 472 publications across 234 different journals. Table 14 shows the number of publications by funding activity. Researchers published their NIOSH-funded research in an array of journals related to occupational safety and health. The journal most frequently published in was *Occupational and Environmental Medicine* (n=43) followed by the *American Journal of Industrial Medicine* (n=39), the *Journal of Occupational and Environmental Hygiene* (n=20) and *Annals of Occupational Hygiene* (n=11). A searchable database of NIOSH publications can be found at Grantee Award Final Reports and Publications on the OEP webpages.

Table 14. Number of publications by funding type, FY2015

Funding Type	Number of Publications
Research Project Grants (R01)	150
Education and Research Center Grant (T42)	140
Agricultural Safety and Health Center (U50, U54, U01)	67
Exploratory Development Grant (R21)	37
National Center for Construction Research and Training (U60)	27
Total Worker Health® (U19)	20
Mentored Research Scientist Development Award (K01)	17
Training Project Grant (T01, T03)	16
State Surveillance Program (U60)	13
Small Research Grant (R03)	11
Research Project Cooperative Agreement (U01)	8
Research Demonstration and Dissemination Grant (R18)	3
Mesothelioma (U19, U24)	2
Conference (R13)	2
Education Projects (R25)	1
Total*	514*

*Total number is greater than 472 publications because a publication could acknowledge more than one source of funding.

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V. APPENDICES

APPENDIX 1: NIOSH FUNDING OPPORTUNITY ANNOUNCEMENTS BY MECHANISM, FY2015

Funding Opportunity	Mechanism	Title
Investigator-initiated Research		
PAR-13-245	K01	Mentored Research Scientist Development Award
PAR-13-129	R01	Occupational Safety and Health Research
PAR-12-200	R03	NIOSH Small Research Program
PAR -14-246	R13	NIOSH Support for Conferences and Scientific Meetings
PAR-12-252	R21	NIOSH Exploratory/Developmental Grant Program
Training Programs and Centers		
PAR-15-352	T03	Occupational Safety and Health Training Project Grants
PAR-15-303	T42	Occupational Safety and Health Education and Research Centers
Cooperative Agreements		
PAR-14-175	U01	Agricultural, Forestry and Fishing Safety and Health Research
PAR-14-229	U13	NIOSH Support for Conferences and Scientific Meetings
PAR-15-361	U19	Centers of Excellence to Promote a Healthier Workforce
RFA-OH-14-010	U24	National Mesothelioma Virtual Bank for Translational Research
PAR-15-303	U54	National Center of Excellence for the Prevention of Childhood Agricultural Injury
PAR-14-227	U60	Workers' Compensation Surveillance
PAR-14-275	U60	State Occupational Health and Safety Surveillance Program
RFA-OH-13-001	U60	National Center for Construction Safety and Health Research and Translation
RFA-OH-14-004	U60	Miner Safety and Health Training Program—Western United States
RFA-OH-14-002	E11	Cooperative Agreement on Occupational Health with the World Health Organization: Implementing "Global Plan of Action for Workers' Health 2008–2017"

(Continued)

Funding Opportunity	Mechanism	Title
Co-Sponsored Research with the National Institutes of Health		
PA-15-269	R43, R44	PHS 2014-02 Omnibus Solicitation of the NIH, CDC, FDA and ACF for Small Business Innovation Research Grant Applications
RFA-TW-14-001	U01	Hubs of Interdisciplinary Research and Training in Global Environmental and Occupational Health (GEOHealth)—Research
RFA-TW-14-002	U2R	Hubs of Interdisciplinary Research and Training in Global Environmental and Occupational Health (GEOHealth)—Research Training

APPENDIX 2: FY2015 EXTRAMURAL PORTFOLIO HIGHLIGHTS

A. Multidisciplinary Centers

NIOSH funds targeted research and outreach activities through multidisciplinary centers, with a focus on high-risk industries that contribute disproportionately to occupational injury and illness in the United States. These centers are funded through a variety of grant mechanisms, including cooperative research agreements and center training grants.

1. Agricultural Safety and Health Centers

a. Overview

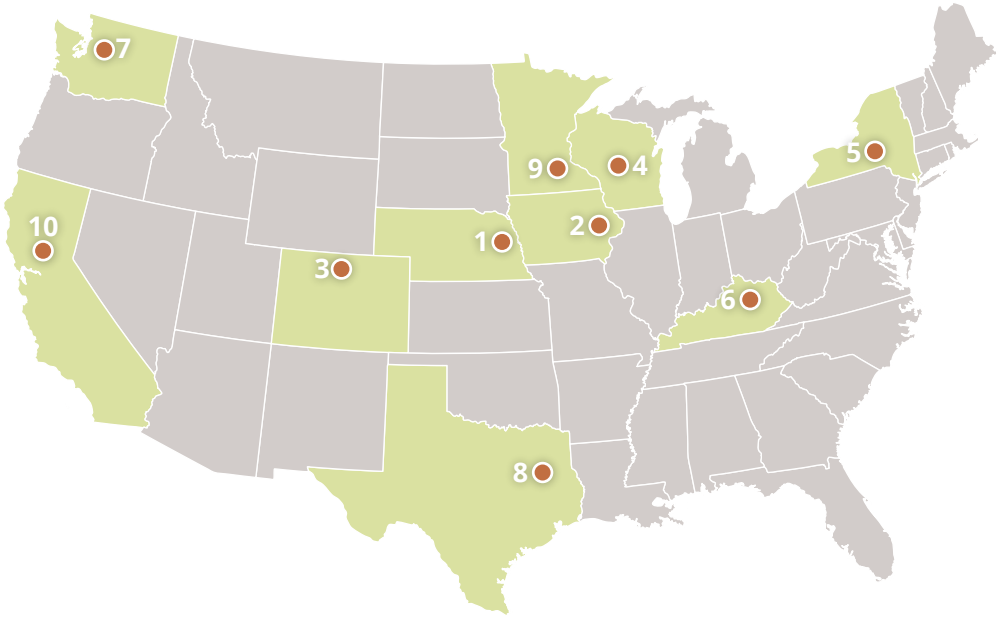
The Centers for Agricultural Disease and Injury Research, Education, and Prevention (Ag Centers) represent a major NIOSH effort to protect the safety and health of agricultural workers and their families. In 1990, the NIOSH Ag Centers were established as a part of the NIOSH Agricultural Safety and Health Initiative. The Ag Centers were established by cooperative agreement to conduct research, education, and prevention projects to address the nation's pressing agricultural safety and health problems. Geographically, the centers are distributed throughout the nation to be responsive to the agricultural safety and health issues unique to the different regions.

b. Public Health Relevance

In 1990, Congress established a national initiative in agriculture safety and health under Public Law 101-517. It was anticipated that this initiative, "… when sustained over a period of time, would result in a significant and measureable impact on … health effects among rural Americans." In response, NIOSH began funding the Centers for Agricultural Disease and Injury Research, Education, and Prevention (Ag Centers) in 1991. The aim was to improve worker safety and health in the agriculture, forestry, and fishing industries—occupations that consistently ranked among the most dangerous in the United States. Currently, NIOSH funds nine regional centers and a national center that focuses exclusively on childhood agricultural risks. Although it is still true today that these occupations rank as some of the most dangerous, there have been significant decreases in overall morbidity and mortality in this work sector since the initiative's inception 25 years ago. These improvements are at least partially attributable to the work done by the Ag Centers during this time.

The Ag Centers' work spans the full research to practice continuum. They conduct basic science to evaluate and quantify a problem, as well as translating these results into engineering controls, educational outreach efforts, or policy changes aimed at preventing or mitigating the problem. Although the Ag Centers' research is fundamental to the creation and validation of evidence-based approaches, the real impacts occur when these approaches are actively implemented through practical education, outreach, and prevention projects within their respective regions. Geographic diversity in agriculture, forestry, and fishing activities drives the need for regional engagement by the centers.

NIOSH Centers for Agricultural Disease and Injury Research, Education, and Prevention



1. University of Nebraska Medical Center, Omaha
2. University of Iowa, Iowa City
3. Colorado State University, Ft. Collins
4. National Farm Medicine Center, Marshfield, WI
5. Bassett Healthcare, Cooperstown, NY
6. University of Kentucky, Lexington
7. University of Washington, Seattle
8. University of Texas Health Science Center, Tyler
9. University of Minnesota, Minneapolis
10. University of California, Davis

The contributions of the Ag Centers to public health include the following:

- Integrating expertise from multiple disciplines, institutions, and community partners to solve complex problems.
- Providing a continuum of basic research through translation and outreach activities that turn findings into evidence-based prevention programs.
- Addressing the many cultural, ethnic, educational, and language obstacles that are significant barriers to safety and health for many laborers in this workforce.
- Contributing expertise to agricultural industries in the fields of medicine, nursing, industrial hygiene, epidemiology, engineering, and education.

c. Program Highlights in FY2015

Regional Centers Focusing on Musculoskeletal Disorders among Agricultural Workers

Due to the physically-demanding tasks and work environments in agriculture, forestry, and fishing (AFF), musculoskeletal disorders (MSDs) are common throughout this occupational sector. It is easy to comprehend the aches and pains associated with planting and harvesting crops, working on a commercial fishing vessel, or felling trees in rough terrain. Many issues contribute to the prevalence of MSDs in this work force, with some hazards being task specific while others more universal across occupations. There is a high reliance on heavy equipment or other mechanically-assisted tasks that pose a threat to many AFF workers. Interactions with unpredictable animals and their herding, flocking, or schooling behaviors lead to contact and associated strains and sprains. Many of these jobs also occur in rigorous environments where one person may be required to do heavy lifting or complete physically challenging tasks with limited or no help from others. Examples of Ag Center projects addressing some aspect of musculoskeletal disorders (MSDs) in 2015 include the following.

Colorado: Preventing Musculoskeletal Disorders in Dairy Parlors

The center at Colorado State is heavily involved in addressing occupational safety and health (OSH) issues in dairy parlors where MSDs are one of the primary concerns. Center projects ranged from outreach and training activities to specific research projects**.** An ergonomist working with the center has a monthly column on health and safety issues in the "Progressive Dairyman," one of the leading publications on the dairy industry. Many of the issues featured in the column are MSD related. The center has been providing safety training since 2009 to dairy producers/owners, managers, and workers in New Mexico, Colorado, and Kansas. Additionally, Colorado's research project, "Exposure Assessment and Intervention Analysis in Large-Herd Dairy Parlors," addresses the health and safety of large-herd dairy workers through assessment and comparison of physical workloads like motion, posture, and muscle forces and their direct effect on worker performance.

Iowa: Musculoskeletal Symptoms among Agricultural Workers

This study examines musculoskeletal symptoms and disorders among agricultural workers. Research findings will provide new information about the physical demands experienced by agricultural workers while performing common tasks and how forceful muscular exertions, awkward postures, repetitive activities and whole-body vibration are linked to the pain, injuries and illnesses of agricultural workers. In particular, whole-body vibration measurements will provide a major contribution to the scientific and practitioner communities' understanding of whole-body vibration and lower back pain among agricultural workers.

Details
http://www.public-health.uiowa.edu/gpcah/center-projects/musculoskeletal-symptoms-among-farmers/

New York: Improving Surveillance of Musculoskeletal Disorder Rates in Northeast Lobstermen

This study is designed to improve the national surveillance of commercial fishing morbidity and mortality by seeking to understand a regionally important fishing industry, lobstering. The study quantifies work exposure by specifically estimating the total population of the lobster-harvesting sector. A questionnaire was utilized in this research to measure the prevalence of musculoskeletal injuries and the body segment injured. Data were collected by phone every 3 months from a cohort of 274 lobster boat captains, and information was obtained via annual face-to-face interviews with captains and crew members. This was a 4-year study that ended in 2015. Preliminary results support the hypothesis that the lobstering sector has a comparably low fatality rate, with specific body segments (wrist, hand, shoulder, and back injuries) being associated with increased risk for injury. Qualitative data have offered a valuable glimpse into important health issues and community concerns. These are namely the lack of ergonomic advice or guidance in the healthcare system. These outcomes will inform future work in reducing outcomes of injury and illness for lobster fishermen.

Details
http://www.nycamh.org/research/current/inshoresurveillance.php

Washington: Ergonomic Evaluation of Emerging Technologies in the Tree Fruit Industry

Tree fruit production activities, such as pruning and structural cutting, green fruit thinning, and fruit harvesting require high-intensity physical labor. Traditionally, these activities are performed from the ground or from ladders. New interventions are being introduced including innovations in hand-held tools (pruners), apple collection systems (vacuums and conveyors), and ladder replacements (mobile platforms). This project aims to perform ergonomic evaluations of these interventions, integrating productivity and safety evaluations into the process of developing new agricultural technologies.

2. National Center for Construction Research and Training

a. Overview

The Center for Construction Research and Training was awarded a NIOSH National Construction Center cooperative agreement for 2014–2019 through an extramural competition. NIOSH intends for this partner, with its diverse construction community, to serve as a leader in applied construction research and to diffuse and disseminate effective interventions to the construction industry. The CPWR, along with its consortium of six academic partners, conducts research to identify causes of and solutions for safety and health risks that construction workers face on the job. Most of the research projects support NORA Construction Sector research goals as well as emerging issues.

b. Public Health Relevance

For the past 25 years, the Center for Construction Research and Training has been funded, through a series of competitive program announcements, as the NIOSH-sponsored Center of Excellence for Construction Safety and Health Research. For FY2015, CPWR's research activities addressed NORA Construction Goals 1 through 15, spanning applied research for hazards and health conditions, research to practice for various construction trades, emerging issues research in nanomaterials, construction industry data and tracking, and dissemination and transfer of research. Research projects also respond to the National Academy of Sciences' recommendations for the NIOSH construction research program, including dissemination and diffusion of research to practice solutions. CPWR has cultivated and optimized external partnerships for prevention, protections, research, and research translation for the protection of construction workers in the United States.

c. Program Highlights in FY2015

CPWR's research received public attention both within and beyond the construction industry during FY2015, in particular the center's work on disparities among construction workers which was cited by federal agencies and professional associations. Examples are demonstrated below:

Research on Hispanic Construction Workers Contributes to National Reports:

More than two thirds of migrant workers were under 25 years of age during their first trip to the United States between 1982 through 2013. Almost 40% of migrants working in construction in America were not construction workers in Mexico. CPWR's research findings and publications on disparities experienced by Hispanic workers are widely cited, including in the Occupational Safety and Health Administration (OSHA) report, *Adding Inequality to Injury: The Costs of Failing to Protect Workers on the Job*, and the American Society of Safety Engineers (ASSE) and NIOSH joint report, *Overlapping Vulnerabilities: The Occupational Health and Safety of Young Immigrant Workers in Small Construction Firms*. CPWR also presented study results on Mexican migrants in the United States at the 2015 National Hispanic Medical Association Conference.

Details
https://www.dol.gov/osha/report/20150304-inequality.pdf
http://www.asse.org/assets/1/7/NIOSHreport_FinalDraft.pdf

APHA Invites Center for Construction Research and Training to Present at National Conference:

The American Public Health Association (APHA) invited CPWR to present at the 143rd APHA Annual Meeting and Exposition in Chicago on the study "Economic Consequences of Workplace Injuries in the United States: Findings from the National Longitudinal Survey of Youth." This annual event draws more than 12,000 public health professionals. In the CPWR study, researchers utilized data from the

National Longitudinal Survey of Youth to examine the effect of work-related injuries on employee wages, income and family net worth. A manuscript based on key findings from this project is currently under review for potential publication in the *American Journal of Industrial Medicine*.

3. Centers of Excellence to Promote a Healthier Workforce

a. Overview

NIOSH has funded Centers of Excellence to explore and research the concepts of *Total Worker Health* (TWH). The centers' research examines the integration and cross-promotion of worker protection, worksite enhancement, and interventions for worker health promotion. The effort strives to recognize the synergy in combining efforts to reduce personal health risk factors with traditional safety and psychosocial stress hazard reduction approaches in the workplace.

Efforts include the following:

- Pilot testing of promising workplace policies and programs.
- Developing and disseminating best practices and tool kits.
- Developing strategies for overcoming barriers to organizational acceptance and adopting comprehensive, coordinated work-based health protection and promotion interventions.
- Investigating costs and benefits associated with integrated programs.
- Promoting increased development and application of physiological and biological markers of stress, sleep, and depression and their use for worker protection or improved health outcomes.

b. Public Health Relevance

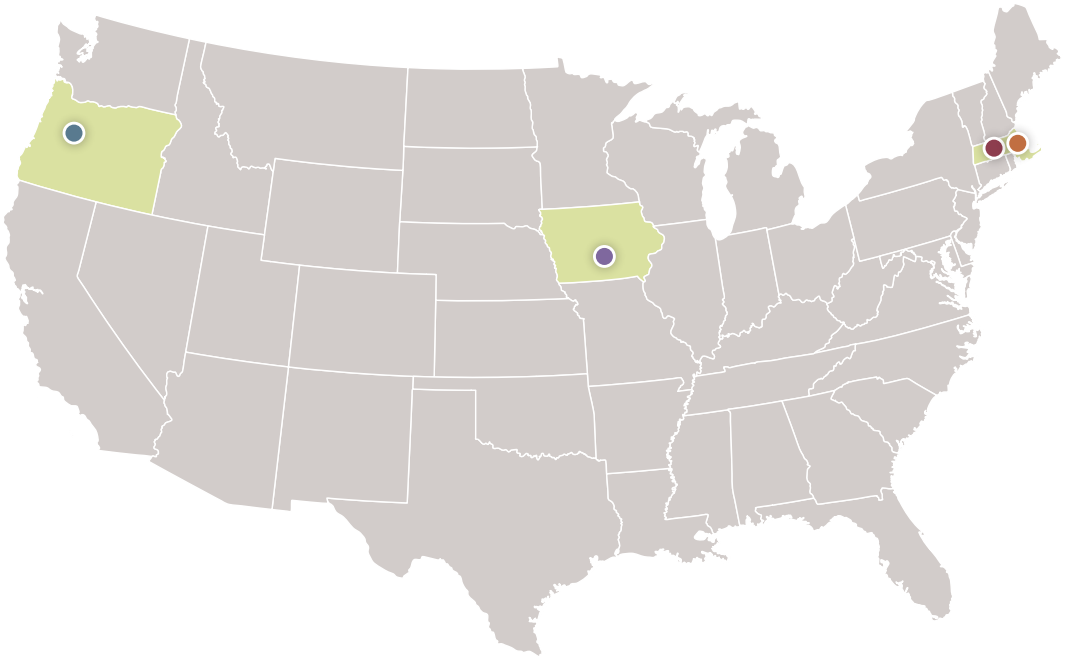
The Centers of Excellence develop and evaluate interventions that have improved safety, health, wellness and well-being—TWH—in high-risk industries that can reduce healthcare costs when adopted on a broad scale. The centers facilitate translation from research to practice, testing the process and feasibility of implementing TWH approaches in real-world environments spanning the multiple sectors of manufacturing, healthcare, and construction. Efforts include an integrative and comprehensive approach to reduce workplace hazards and promote worker health, through its identification of the links between workplace culture and personal high-risk behaviors, as well as issues that transcend the workplace, such as work-family strain.

c. Selected Program Highlights FY2015

Building the TWH Knowledge Base

SafeWell Practice Guidelines Found Effective for Implementing TWH in Small to Medium-Sized Companies:
The Harvard Center for Work, Health, and Well-being developed the SafeWell project to build on its guidelines for implementing TWH approaches, also known as "The SafeWell Practice Guidelines: An Integrated Approach to Worker Health." The

Centers of Excellence for Total Worker Health®



Oregon Healthy Workforce Center (OHWC)

Center for the Promotion of Health in the New England Workplace (CPH-NEW)

University of Iowa Healthier Workforce Center for Excellence (HWCE)

The Harvard T.H. Chan School of Public Health Center for Work, Health and Well-being

SafeWell project is now focused on the adoption of TWH strategies by small to medium-sized businesses (SMBs) through these guidelines. During FY2015, the center partnered with a health and wellness vendor to examine the feasibility and acceptability of delivering TWH approaches in three SMB pilot sites. Vendors often provide health and safety services to small to medium-sized employers that lack in-house resources, but they rarely provide TWH approaches. A key lesson learned from this study is that, despite limited resources to adopt and implement TWH approaches, there are examples of SMBs successfully utilizing them. The center concluded that company size was not a barrier to implementation and TWH assessment tools were valid and valuable to these businesses. Factors that facilitated this vendor-delivered approach to TWH include openness to change and innovation, leadership support, committed staff, budgets, and committees, along with collaborative, organizational cultures that prioritize worker health, safety, and well-being. The SafeWell Guidelines are utilized globally to inform organizations about ways they may conduct integrated approaches to worker health and well-being. This resource

is free and available for download on the Harvard T.H. Chan School of Public Health Center for Work, Health, and Well-being website.

Details
http://centerforworkhealth.sph.harvard.edu/resources/safewell-resources

Centers of Excellence Influencing State Standards, Guidance and Policy Setting

CPH-NEW Researchers Contribute Knowledge to Massachusetts Department of Public Health Task Force Report on Safe Patient Handling:
Nursing home workers are at a high risk for lower back injury and other muscle and joint issues because of the physical demands of their jobs. The Center for the Promotion of Health in the New England Workplace (CPH-NEW) conducted a multiphase study focused on this population, "Promoting Physical and Mental Health of Caregivers through Trans-disciplinary Intervention (ProCare)." The ProCare Phase I study evaluated the utilization of safe resident handling equipment in nursing facilities and the second phase focused on the long-term effectiveness of the Safe Resident Handling Program. In particular, ProCare Phase II examined specific organizational factors that influence the safety, health, and satisfaction of nursing home workers and their residents. In the study, CPH-NEW produced evidence that a comprehensive Safe Resident Handling Program had multiple benefits, including lower rates of workers' compensation claims for back injuries and other musculoskeletal disorders and a rapid financial return on investment. The study resulted in the Massachusetts Department of Public Health inviting the CPH-NEW principal investigator to serve on its Hospital Ergonomics Task Force. During FY2015, the Task Force released a report, "Moving into the Future: Promoting Safe Patient Handling for Worker and Patient Safety in Massachusetts Hospitals." Additionally, both the Institute of Medicine and the Veterans Health Administration have recognized the ProCare research results.

Details
https://www.uml.edu/Research/CPH-NEW/Research/long-term-care.aspx
http://www.mass.gov/eohhs/gov/departments/dph/programs/admin/dmoa/data-reports-and-publications-.html

Evaluating Stress Resilience – An Intervention to Reduce Stress and Cardiovascular Disease Risk Factors in Police:
Police officers experience high levels of stress and high incidence of cardiovascular disease. The University of Iowa Healthier Workforce Center (HWC) addressed this important need through a 3-month intervention that involved educating police officers on techniques to manage emotional and physical stress responses. The officers also participated in practice sessions, where they worked on acquiring stress management skills while utilizing a hand-held heart monitor to support the process. Results from this study indicated improvement in resilience to stress, positive changes in heart rate, and lower levels of post-traumatic stress disorder and vital exhaustion, including experiences of excessive fatigue, increased irritability, and

feeling demoralized. Understanding the levels of stress officers report and how to modify their reaction to stress may reduce rates of cardiovascular disease in police officers and could help police departments retain employees. These research findings were disseminated at the 1st International Symposium to Advance TWH and the American Public Health Association Annual Meeting in New Orleans, Louisiana, as well as presented to police leaders at the International Association of Chiefs of Police in Alexandria, Virginia. Additionally, the principal investigator of the study provided testimony regarding ways to improve police officers' health and wellness to President Obama's Task Force on 21st Century Policing in February 2015. This research was also highlighted in the September 2015 issue of *Charting Nursing's Future*, a newsletter published by the Robert Wood Johnson Foundation.

Details
http://www.public-health.uiowa.edu/hwcmw/evaluating-stress-resilience-a-new-worksite-intervention-to-reduce-stress-and-cvd-risk-factors-in-police/

Far-reaching Awareness and Dissemination of Integrated Approaches

Efficacy of a Combined Ergonomic Health Promotion Intervention on Employee Health Featured in U.S. News:
Keeping employees who work in sedentary jobs healthy is an important public health problem. To address this issue, the University of Iowa Healthier Workforce Center tested an intervention focused on office workers becoming more active. The intervention included ergonomic adjustments to each employee's workstation, along with replacing office workers' sedentary workstations with active workstations that include pedal machines at their desks. Study outcomes include workers who received the intervention significantly increasing the percent of daily work time spent engaging in physical activity. They used the pedal machines for nearly 50 minutes per day. Workers who used the pedal machines also showed changes in multiple health outcomes including resting heart rate, weight, and percent body fat. These findings suggest that providing sedentary employees with work access to a relatively low cost, portable pedal machine that allows for engaging in light intensity activity is effective. It also is a potentially sustainable approach for improving the health of sedentary working adults. Findings from this study were published in the *American Journal of Preventive Medicine* and featured in more than 100 news outlets including *The Atlantic, Yahoo News, Christian Science Monitor, Consumer Reports on Health, and Science Daily*.

Details
http://www.public-health.uiowa.edu/hwcmw/efficacy-of-a-combined-ergonomic-health-promotion-intervention-on-employee-health/

The Global Impact of "Executive and Continuing Professional Education: Integrated Employee Health Program":
The Harvard Center for Work, Health, and Well-being strives to educate professionals about integrated approaches to TWH through its "Executive and Continuing Professional Education: Integrated Employee Health Program." The annual course is designed to provide participants with skills to implement TWH integrated

approaches to employee health programs, evaluate the effectiveness of workplace health strategies, and assess the financial impact of integrated programs. The course had global reach in FY2015 via 43 course participants who were practitioners and researchers from 14 states and seven countries spanning five continents. The dissemination impact of the course includes the center developing new national and global partnerships with governmental, social service, and industrial sectors to collaborate on advancing and disseminating integrated approaches to TWH.

Details
http://centerforworkhealth.sph.harvard.edu/events/work-health-and-well-being-frameworks-evidence-and-applications

Symposium Broadens View of Worker Safety and Health for Audience of More Than 100:

Employers increasingly believe both safety and health are critical to the well-being of their workers and their businesses and are eager to learn and share the latest evidence-based strategies. In April 2015, the University of Iowa Healthier Workforce Center and the Heartland Center for Occupational Health & Safety in the College of Public Health at the University of Iowa jointly sponsored the 17th Annual Occupational Health Symposium, which focused on TWH. More than 100 practitioners, employers, academics and students attended the conference. During this event, business leaders and researchers shared their expertise in addressing issues such as safety, ergonomics, psychosocial stress, prolonged sitting and lack of movement, fatigue, poor work organization, and unhealthy food choices – all of which can be hazardous in the workplace.

Utilization of Integrated Approaches to Improve Worker Health, Safety, and Well-being

Plans Underway to Roll Out Health and Safety "Communities of Practice" for Home Care Workers in Oregon:

The Oregon Healthy Workforce Center (OHWC) reports the injury rate for home care workers is four times higher than the national average. These workers who support individuals who are elderly or have a disability with self-care and mobility inside of their homes, are also at an elevated risk for mental and physical health issues. Home care workers are a vulnerable population with a limited support structure. OHWC developed and implemented "The Community of Practice and Safety Support (COMPASS)" to address this problem. This intervention utilizes a peer-led scripted curriculum to organize home care workers into neighborhood-based teams that provide education and social support for improving lifestyle (e.g., diet, exercise) and safety behaviors. Through NIOSH funding, the center pilot-tested COMPASS in partnership with the Service Employment International Union Local 503 and the Oregon Home Care Commission. Research results indicate that COMPASS improves home care workers' safety and health knowledge and enhances their professional social networks. The program also resulted in home care workers having improved safety and health practices that include the use of ergonomic tools.

Because of these positive outcomes, the Oregon Home Care Commission plans to extend use of COMPASS beyond pilot testing the intervention in three cities to a statewide roll out of the program through its training system. This move will make COMPASS available to 60% of home care workers in the state of Oregon.

Details
http://www.ohsu.edu/xd/research/centers-institutes/oregon-institute-occupational-health-sciences/oregon-healthy-workforce-center/projects/compass/index.cfm

State of Oregon Adopts Supervisor Training to Promote Health and Safety in Construction:
Supervisors are critical to implementing workplace programs that address TWH related issues. These leaders can facilitate the process by educating employees and themselves about healthy lifestyles and safe work practices, and encouraging workers to adopt them. However, the Oregon Healthy Workforce Center (OHWC) points out that, while many supervisors have technical knowledge, few of them have these supervisory skills. The center aims to enhance supervisor team building skills in Latino and non-Latino construction supervisors via a 12-week course supported by behavior-tracking technology. The course, which is offered in English and Spanish, is a scripted healthy lifestyle training implemented in small groups to motivate construction workers to adopt healthier lifestyle choices and safer work practices. OHWC conducted two pilot tests with construction companies, and results from one completed study indicate positive outcomes. These changes include an increase in workplace safety compliance and team cohesion, and supervisors substantially enhanced their level of job and family support when communicating with workers. These leaders also demonstrated a boost in healthy lifestyle knowledge and improved their own nutrition, exercise, and sleep habits. Following these results, the Oregon Bureau of Labor and Industries decided to fund the training for construction workers in the state.

Details:
http://www.ohsu.edu/xd/research/centers-institutes/oregon-institute-occupational-health-sciences/oregon-healthy-workforce-center/projects/supervisor-training.cfm

City of Portland Adopts TWH Tools for Young Workers:
Young workers, ages 14 to 24, are at a heightened risk for occupational injuries for a multitude of reasons. The Occupational Safety and Health Administration (OSHA) identifies these as a lack of job experience, inability to identify workplace hazards, and reluctance to ask questions, along with the cognitive and physical developmental state of youth. The Oregon Healthy Workforce Center (OHWC) developed the internet-delivered training, "Promoting U through Safety and Health (PUSH)," to advance safe work practices and healthy lifestyle choices in young workers. The training combines the "NIOSH Talking Safety–Youth at Work" curriculum with health promotion and communication topics and has a social media component via Tumblr messages. OHWC implemented and evaluated the use of PUSH with varied groups including youth employed in the food service industry and park and

recreation workers. Study results indicated that young workers favored PUSH and that PUSH led to significant improvements in their safety and health knowledge. Moreover, in 2015, the City of Portland adopted the PUSH training for new seasonal parks and recreation workers.

Details
http://www.ohsu.edu/xd/research/centers-institutes/oregon-institute-occupational-health-sciences/oregon-healthy-workforce-center/projects/twh-young-workers.cfm

4. Education and Research Centers

a. Overview

NIOSH supports professional training in occupational safety and health through training programs in Education and Research Centers (ERCs). ERCs are university-based, multidisciplinary centers that provide graduate training in the core and allied fields of occupational safety and health. ERCs also provide continuing education and outreach to the occupational safety and health community throughout the federal health region they serve. ERCs are interdisciplinary programs that address safety and health training and research training in a crosscutting and integrated manner. ERCs are the major part of a network of training grants that help ensure an adequate supply of qualified professional practitioners and researchers. Outreach and research to practice activities with other institutions, businesses, community groups, or agencies located within their region are essential ERC components. Programs are encouraged to address area needs and implement innovative strategies to meet those needs, with a focus on worker health and safety.

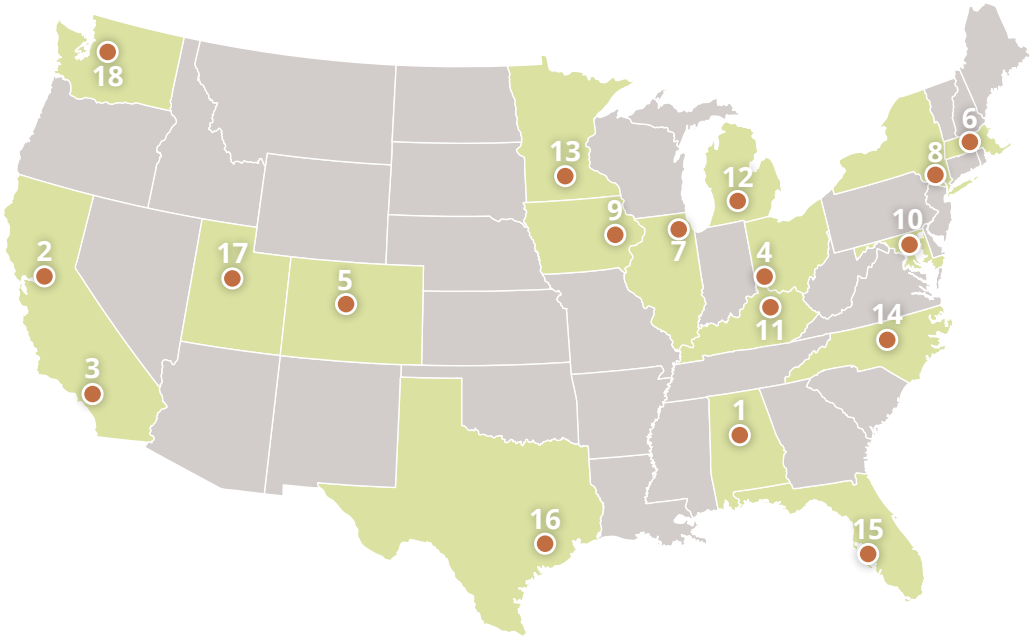
b. Public Health Relevance

The Occupational Safety and Health Act of 1970 (Public Law 91-596) establishes the NIOSH mandate to conduct education programs to ensure an adequate and steady supply of qualified personnel in this discipline. NIOSH responds to this mandate by funding training programs in the core and allied disciplines of occupational safety and health to increase the number and competencies of the occupational safety and health workforce in the United States. NIOSH-funded Education and Research Centers are central to this mandate and serve a vital role in protecting and promoting the health and safety of the nation's workforce. Aligning with the goals of Healthy People 2020—to prevent diseases, injuries, and deaths that are due to working conditions—ERCs improve occupational safety and health through education, research, and collaboration. They are the regional and national resource on these issues for business, labor, government, and the public.

ERCs meet the critical need to produce researchers and practitioners—vital to maintaining workplace health and safety—and reducing the burden of preventable work-related injuries, illnesses, and fatalities by performing the following actions:

- Providing the U.S. workforce with the occupational safety and health expertise needed to reduce the burden of occupational injuries, illnesses, and fatalities.

NIOSH Education and Research Centers by DHHS Region



1. University of Alabama at Birmingham
2. University of California, Berkeley
3. University of California, Los Angeles
4. University of Cincinnati
5. University of Colorado Denver
6. Harvard University
7. University of Illinois at Chicago
8. Icahn Mount Sinai School of Medicine
9. University of Iowa
10. Johns Hopkins University
11. University of Kentucky
12. University of Michigan
13. University of Minnesota
14. University of North Carolina at Chapel Hill
15. University of South Florida
16. University of Texas Health and Science Center at Houston
17. University of Utah
18. University of Washington

- Developing the major research innovations needed to prevent occupational injuries, illnesses, and fatalities in the United States.
- Providing regional and industry-specific outreach and consultation to more than 5,000 small-, medium-, and large-sized U.S. businesses annually.
- Serving as the primary source of accessible experts to the public and government leaders for occupational safety and health issues, while not duplicating any other U.S. government program.

c. Selected Program Highlights FY2015

Trainees, Graduates, and Employment of Graduates

In academic year 2014–2015, 285 students graduated from ERC programs with specialized training in disciplines that included industrial hygiene, occupational

health nursing, occupational medicine, occupational safety, and other closely related occupational safety and health fields of study. A highlight for FY2015 is that the percentage of ERC graduates who were employed or seeking employment increased from 89% in FY2014 to 98% in the current fiscal year. The following table shows the number of students enrolled, graduates, and employment status during FY2015.

ERC Trainees, Graduates and Employment, FY2015

Program Area	Enrolled	Graduates	Employed or seeking occupational safety and health employment (%)
Industrial Hygiene	199	85	85 (100)
Occupational Health Nursing	132	41	41 (100)
Occupational Medicine	71	27	27 (100)
Occupational Safety	78	34	34 (100)
Other Related Disciplines	283	98	92 (94)
Total	763	285	279 (98)

ERC graduates work in a variety of industries related to occupational safety. The placement of FY2015 graduates is shown in the following table by program area and work setting. Graduates who are seeking employment in the occupational safety and health field and have not taken employment outside their field are considered as remaining in the field.

ERC Graduate Employment by Work Setting, FY2015

Work Setting/ Program Area	Industrial Hygiene (n=85)	Occupational Health Nursing (n=41)	Occupational Medicine (n=27)	Occupational Safety (n=34)	Other (n=98)	Total (N=285)
Academic Institution	16	4	2	6	33	61
Clinic/Hospital	0	18	8	1	5	32
Federal Government	14	0	2	5	15	36
Private Industry	37	8	7	10	25	87
State/Local Government	6	1	1	2	2	12
Other OSH Employment	0	0	0	0	6	6
Seeking OSH Employment	11	7	7	0	4	29
Seeking OSH Advanced Degree	1	3	0	10	8	22
Total	85	41	27	34	98	285

Continuing Education Outputs

A required component of ERCs is continuing education of occupational safety and health professionals. Each year, NIOSH ERCs train thousands of these professionals around the United States through course offerings in the occupational safety and health core and related disciplines. The following table shows the continuing education activity by discipline. In FY2015, the ERCs provided more than 408,000 person hours of training to more than 55,000 occupational safety and health professionals, through 1,884 courses.

Continuing Education Courses by Discipline, FY2015

Discipline	Number Courses	Number Trainees	Person-Hours of Training
Industrial Hygiene	215	4,104	56,070
Occupational Health Nursing	220	6,029	53,036
Occupational Medicine	224	9,102	38,395
Occupational Safety	933	9,348	171,768
Ag Safety and Health	37	1,819	9,214
Other	255	25,520	80,252
Total	1,884	55,922	408,735

Ebola Webinar Increases Awareness for Hundreds

In response to the Ebola crisis, faculty and staff at the Icahn Mount Sinai School of Medicine (New York / New Jersey ERC) collaborated with leaders from the NIOSH National Personal Protective Technology Laboratory to develop a webinar that provided critical information on how healthcare providers and emergency personnel should use personal protective clothing to protect themselves. The webinar, with expert content, provided an overview of the protective clothing selection process, standard test methods for blood and viral penetration resistance, current healthcare protective clothing (gown and coverall) standards and specifications, and ongoing research projects for Ebola. Nearly 200 individuals viewed this webinar live; an archived recording of the presentation is currently available.

Leveraging Partnerships to Enhance Resources

The Texas ERC (Southwest Center for Occupational and Environmental Health) partnered with Shell Oil Company to honor the legacy of Marcus M. Key, MD, by establishing an endowed faculty chair in occupational and environmental health. Dr. Key, the founding director of NIOSH and a longtime faculty member at University of Texas Health Science Center at Houston, contributed greatly to the field of occupational health and safety, in particularly in the areas of teaching and mentoring. The funding for the endowed chair will be used to recruit and retain senior faculty.

Protecting Workers in Emerging Issues and Emerging Industries

At the University of Washington ERC (Northwest Center for Occupational Health and Safety), efforts continued in supporting sustainability and green chemistry in the northwestern region through new partnerships with pollution prevention organizations and practitioners in the biotechnology industry. The center's director provided his expertise on regional and state-wide advisory boards and has presented to safety and health practitioners and researchers on the role of chemical substitution for improving worker safety and health in green chemistry (safer chemicals, smart energy, and sustainability). The University of Washington has developed a Sustainability Green Lab Certification Program for individuals to develop and implement best practices for transitioning to safer chemicals and in the use and design of 21st century chemicals.

Additionally, workers' compensation data show that animal workers have high rates of work-related injuries and illnesses. A new academic program, Occupational Health at the Human-Animal Interface, at the University of Washington ERC will provide research, training, and education on a workforce that has been lacking in occupational health services as well as health and safety preventive services.

Selected Student Impact: Developing Multi-disciplinary Collaborations

For more than 13 years, the ERC at the University of Utah has offered its annual National Occupational Research Agenda Young / New Investigators Symposium. The goal of this conference is to assemble interested undergraduate and graduate students and young and new investigators from across the United States in a forum where NORA-related research is presented and discussed. Representatives from 10 different universities attended this year's event, nearly all of whom made podium presentations. Utah sets an atmosphere for an exchange of ideas, and, for many of the student presenters, it is their first formal research presentation. Through its collaborative spirit, the symposium has developed a history of reaching new occupational safety and health investigators across disciplines and forging new relationships among students, faculty, and researchers.

B. Investigator-initiated Research

1. Research Grants

a. Overview

The goal of the NIOSH extramural research program is to support relevant and high-quality scientific investigation that reduces occupational disease and injury. NIOSH responds to that goal by funding investigator-initiated research. These diverse awards include funding for large occupational safety and health research projects (R01), small research grants (R03), and exploratory research grants (R21). The extramural research portfolio includes mentored research scientist development awards (K01) that provide mentored training for the next generation of occupational safety and health scientists. These highly competitive K01 awards provide up to 3

years of funding and a scientific focus designed to develop the skills and productivity of new career scientists.

b. Public Health Relevance

Large Occupational Safety and Health Research Grants (R01)

The purpose of this funding opportunity is to develop an understanding of the risks and conditions that are associated with occupational diseases and injuries, to explore methods for reducing risks and for preventing or minimizing exposure to hazardous conditions in the workplace, and to translate significant scientific findings into prevention practices and products that will effectively reduce work-related injuries, illnesses, and fatalities.

Small Research Grants (R03)

This grant mechanism supports different types of projects, including pilot and feasibility studies; secondary analysis of existing data; small, self-contained research projects; development of research methodology; and development of new research technology. The R03 is intended to support small research projects that can be carried out in a short time with limited resources.

Exploratory Grant Program (R21)

The R21 mechanism is intended to encourage new exploratory and developmental research projects. For example, such projects could assess the feasibility of a new area of investigation or a new experimental system that has the potential to enhance health-related research. Another example could include the unique and innovative use of an existing methodology to explore a new scientific area. These studies may involve high risk/high reward that may lead to a breakthrough in a particular area or to the development of novel techniques, agents, methodologies, models, or applications that could have a major impact on a field of biomedical, behavioral, or clinical research. Applications for R21 awards should describe projects distinct from those supported through the traditional R01 mechanism. Projects of limited cost or scope that use widely accepted approaches and methods within well-established fields are better suited for the R03 small grant mechanism.

c. Selected Program Highlights FY2015

Highlights from R01 Grants

Autonomous Electrochemical Gas Detection Microsystem Developed for Mine Safety

Despite continued safety improvements and increased regulations, underground mines remain a very dangerous work environment. This is evident from gas explosions and numerous reports of worker injury in mines. Many handheld portable gas sensors have been developed, but none of them meet the challenging cost, utility, and capability requirements that currently prevent the widespread use of hazardous gas monitors in mines. This project aimed to develop technologies and techniques

that would result in a widely used gas monitoring system by mine workers to monitor exposures to gas hazards. The system would monitor this type of exposure autonomously, in real time, over extended periods and in the real-world mine environment. This research has led to a sensor system that has multi-gas sensing capabilities and affordable system implementation, and it lays the foundation for multidimensional gas sensing at low power and low cost. The project demonstrated a unique system-level approach to gas sensing that incorporates electrochemical sensors, microelectronics instrumentation, and embedded sensor processing algorithms. This system can be designed to interface with modern wireless monitoring technologies for wearable gas sensors in mines. Because of this project, new gas sensors are available with patented and sustainable performance and cost advantages over existing technologies. The gas sensors are expected to improve worker safety, particularly in underground mines. Future sensor and sensor system research can potentially lead to new patents for technology transfer and commercialization. This new technology is also directly related to applications in improved emission control and personal protection.

(R01 9644, Project Title "Autonomous Electrochemical Gas Detection Microsystem for Mine Safety," Mason)

Carpal Tunnel Syndrome Research Influences National and Global Guidance and Policy Setting

Carpal tunnel syndrome (CTS) is a common and disabling work-related upper extremity musculoskeletal disorder (UE MSD). This medical condition is related both to personal factors such as age and obesity and intensive hand use in the workplace, mediated by factors like forceful grip and repetitive hand activity. This project focused on understanding of the etiology, long-term outcomes, and prevention of CTS and resulted in these significant research findings:

- Study found strong evidence that frequent and forceful hand activity is an independent risk factor for CTS and other UE MSD after controlling for age, gender, obesity, and other non-work related risk factors.
- Study concluded that workers with CTS are more likely than similar types of workers without CTS to have permanent hand symptoms and functional impairment, including work-related disability.
- Study determined that work-related musculoskeletal disorders (MSD) are substantially underreported in workers' compensation insurance with claims and costs often shifted to general health insurance programs. These practices impede surveillance efforts and lead to underestimates of the true illness and cost burden of work-related MSD.
- Study assessed the practice of screening workers for CTS using nerve conduction studies after they have been offered employment, but prior to job placement. Research showed that this common employer practice is not a useful or valid preventive measure and should be abandoned.

- Study created and validated simplified methods for exposure assessment relevant to UE MSD and validated epidemiologic case definitions for carpal tunnel syndrome.

The Occupational Safety and Health Administration, Colorado, Washington State and countries including Britain, New Zealand, France, and Germany have incorporated these research findings into government guidelines and policy reports related to CTS. The results are also cited in a current U.S. Equal Employment Opportunity Commission lawsuit related to post-offer, preplacement screening for CTS. National educational materials for physicians, pharmacists, and safety professionals also cite this study.

Details
https://oshr.wustl.edu/worker-safety-and-health/worker-health-and-productivity-4/popp-screening/
(R01 8017, Project Title "Post-offer Screening and Risk Factors for CTS," Evanoff)

Research Links Long-Term Job Stress for Police to Cardio-metabolic Disease

Certain characteristics of police work like long work hours, shift work, high demands, and traumatic exposures have been associated with increased levels of psychological stress and, in some cases, adverse cardiovascular issues. This observational study aimed to provide robust evidence that the workplace stressors police officers face lead to the development of negative physiological and psychological health outcomes. More than 280 police officers participated in this follow-up study in which the investigators had prior baseline data on the officers and a protocol infrastructure. Researchers tracked the officers for more than 4 years and demonstrated that the stressors they experience on the job resulted in physiological and psychological health problems over time. In particular, the results contributed to a better understanding of how prolonged exposure to work and life stressors are associated with early indicators of cardiovascular and metabolic abnormalities in police officers. Researchers presented these findings to academics and police stakeholders throughout the United States and published in academic and police trade journals. This study can be translated into improved prevention practices among police officers and, therefore, benefit a large proportion of the working population.

Details
http://www.buffalo.edu/ubreporter/archive/2011_02_03/police_stress
(R01 9640, Project Title "Stress and Subclinical Cardio-Metabolic Disease in Police: A Longitudinal Study," Violanti)

Study Increases Accuracy of Method for Assessing Occupational Exposure to Titanium Dioxide

University of Iowa investigators developed a nanoparticle respiratory dose sampler that provided a cost-effective means for collecting nanoparticles. This innovative technology also had broad application to quantifying low levels of metal-based nanoparticles. Building on this discovery, researchers focused on creating proven sampling and analysis methods for assessing exposures to metal-based

nanoparticles. Researchers developed a method to accurately quantify titanium dioxide (TiO2) particles on air filters made of polyvinyl chloride and mixed-cellulose ester. TiO2 particles are commonly used in consumer products. This finding is significant because it challenged the effectiveness of Method 7300, which NIOSH recommended for assessing worker exposure to TiO2 in the publication, "Current Intelligence Bulletin 63: Occupational Exposure to Titanium Dioxide." Method 7300 demonstrated a recovery for TiO2 of 21% compared to 94% for the method developed in this study. Researchers partnered with construction and farm equipment company John Deere, and the U.S. Air Force to conduct field sampling to validate the soundness of this sampling and analytical technique in real world settings. Researchers also provided NIOSH with the nanoparticle respiratory dose sampler for field testing of nanoparticles in a nanocellulose production factory.

Details
https://peters.lab.uiowa.edu/nanoparticle-respiratory-dose-nrd-sampler
(R01 10238, Project Title "A Nanoparticle Respiratory Dose Sampler for Metal-Based Nanoparticles," Peters)

Translation of a Robbery and Workplace Violence Prevention Program to High Risk Businesses

Workplace violence is the third leading cause of workplace death in the United States, disproportionately affecting workers in the retail, accommodation and food services, and taxicab sectors, according to the Bureau of Labor Statistics. The Bureau reports that more than half of all workplace homicides occur in the retail and food service sectors – the majority are robbery-related. The principal investigator of this project previously conducted studies concluding that evidence-based programs to reduce robbery and violent crime demonstrate great success in the retail and food service sectors. However, these programs are only effective if owners or managers (business operators) opt to implement them. Information about how to successfully disseminate these programs and encourage business operator participation, especially in small businesses, is largely unknown. This translational study intended to identify optimal and sustainable methods for law enforcement to recruit businesses to participate in an evidence-based robbery and violence prevention program, as well as achieve high levels of compliance to program recommendations. The project involved six police departments that disseminated an evidence-based robbery and violence prevention program, called Crime Free Business, to high risk companies in their jurisdictions. Crime Free Business includes a 2-hour training for business owners and an onsite security evaluation. During the study period, more than 1,000 businesses were approached as potential research participants, and 322 (32%) participated in the program. The study resulted in the program being implemented with high fidelity among these businesses and identified measures to overcoming barriers that businesses face in participating in evidence-based robbery and violence prevention programs. The International Crime Free Association is now disseminating the program to its membership. The program, Crime Free Business, is currently available to more than 2,000 law enforcement agencies nationally and internationally through the association.

Details
http://www.crime-free-association.org/business.htm
(R01 9527, Project Title "Translation of a Robbery and Workplace Violence Prevention Program to High Risk Businesses," Casteel)

Highlights from R21 Grants

Digital Video Expands Methods of Repetitive Motion Exposure Assessment
The American Conference of Governmental Industrial Hygienists (ACGIH®) Threshold Limit Value (TLV) for Hand-Activity Level (HAL) is an analytical tool utilized to assess repetitive motion exposure and is based on an individual's level of hand activity while performing short-term job tasks. HAL and other similar methods of measuring this type of exposure to assess job risk of hand and wrist musculoskeletal disorders are mainly used in research studies and not by occupational safety and health practitioners. These traditional methods are limited in use because they involve either direct measurements using instruments attached to workers' hands or arms or indirect observations and such approaches are not practical for practitioners. Moreover, there has not been a feasible instrument that measures repetitive motion exposure in a way that is objective, unobtrusive, and efficient. This project aimed to address this problem by investigating the feasibility of using digital video processing to automatically evaluate HAL. The research focused on developing video processing algorithms that would quantify hand activity level in real time using conventional digital videos. This new approach leveraged a vast database of videos and associated exposure data that were analyzed manually through collaboration with the University of California Berkeley. Through the study, researchers found that digital video can be used to automatically measure repetitive motion exposure in an objective and discreet manner. This approach is advantageous over traditional methods of this type of exposure assessment because it is does not involve attaching sensors to workers' bodies. Traditional methods often interfere with employees' jobs and possibly movement patterns and exertions. In comparison, use of digital video requires minimal human interference and possibly allows for real-time analysis. It is anticipated that, in the future, this method will be implemented on camera-enabled handheld devices, such as a smartphones or tablets, making it widely available to industry practitioners.

Details
https://pantherfile.uwm.edu/schmi427/www/Abstracts/Radwin_Abstract_Fall2011Seminar.pdf
(R21 10221, Project Title "Video Exposure Assessment of Hand," Radwin)

Increased Capacity to Detect Nanomaterials in Human Body Tissue
Engineered nanomaterials (eNMs) are widely utilized in many technology fields and are being used more often in industrial applications and consumer products. Because of these factors, concerns exist over the health and safety risk of these materials, and a particular concern is for occupational exposure related to eNMs. Researchers have previously attempted to measure the interaction of nanomaterials with biological systems and develop predictive models for health and safety risk to

nanoparticles. However, detection of eNMs in the environment and in the body is challenged by limitations of analytical techniques. This research strived to overcome this challenge by developing a set of reagents (NProbes) that can be used to improve the detection of eNMs in human body tissue. During this study, researchers successfully produced NProbes for detecting nanoparticles in human skin, such as fluorescent quantum dots and nonfluorescent titanium dioxide. This study investigated the NProbes' reactivity binding to similar and dissimilar nanomaterials and proved that NProbes can detect quantum dots that could not be seen above background tissue autofluorescence. Investigators describe their work as groundbreaking, asserting that this is the first time a nanoparticle binding antibody has been reported. It is expected that, with future refinement, NProbes will be able to detect nanoparticles of varying composition, size, and surface coating.

(R21 9970, Project Title "Reagents to Enhance Detection of Raw and Biologically Transformed Nanomaterials," DeLouise)

Using Injury Severity to Improve Occupational Traumatic Injury Trend Estimates

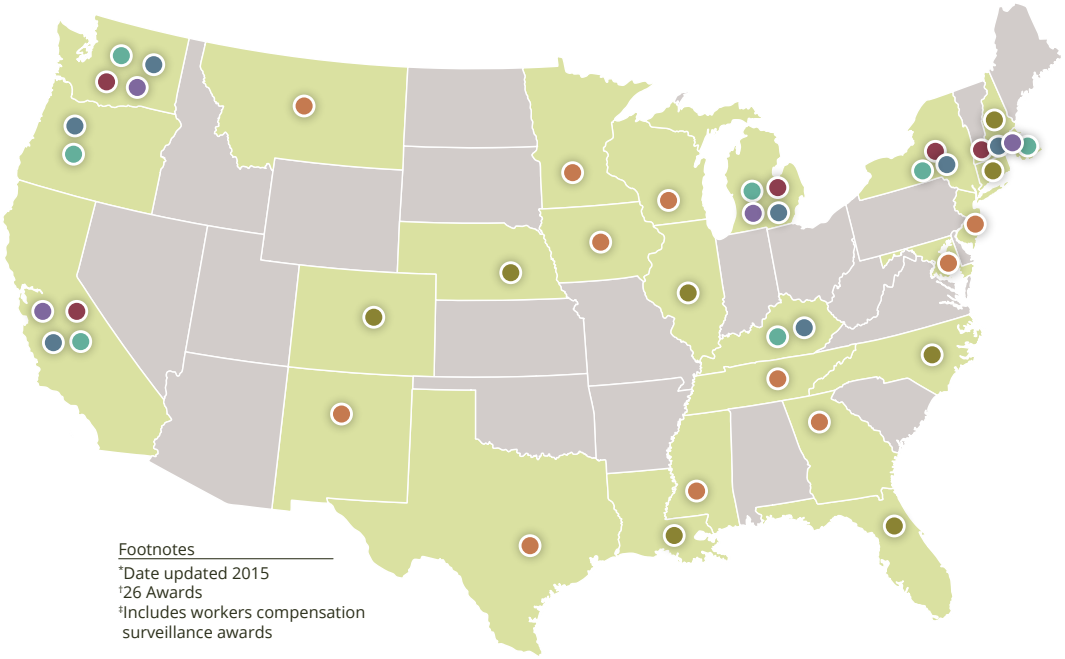
Acute work-related trauma is a leading cause of death and disability among American workers and is very costly for injured workers, employers, workers' compensation systems, and society as a whole. Accurate characterization of injury trends is critical to prevention planning and evaluation. This study investigated methods to improve injury trend estimation and produced information and tools directly useful for occupational injury surveillance and research. A key outcome from the project was the development and adoption of the Council of State and Territorial Epidemiologists Occupational Health Indicator #22 "Work-Related Severe Traumatic Injury Hospitalizations" for state-based surveillance. One challenge that existed for state public health and occupational health programs in utilizing the health indicator was the lack of a simple and clear definition for surveillance of severe injuries. However, researchers addressed this problem by developing a list of severe traumatic injury ICD-9-CM diagnosis codes that roughly corresponds to injuries with an Abbreviated Injury Scale of 3 (serious) or above. This list is included in the guidance for Occupational Health Indicator #22.

Details
http://www.cste.org/?OHIndicators#
(R21 10307, Project Title "Success for Surveillance Research Method Development: Using Injury Severity to Improve Occupational Traumatic Injury Trend Estimates," Sears)

C. Cooperative Research Agreements

Cooperative agreements provide NIOSH with the ability to arrange collaborative surveillance and research opportunities with state health departments, universities, labor unions, and nonprofit organizations. NIOSH provides funding for a broad array of cooperative agreements to develop knowledge that can be used in preventing occupational diseases and injury. In FY2015, NIOSH funded the state surveillance program to support capacity development among states to conduct surveillance of occupational injuries, illnesses, fatalities, and hazards. NIOSH also provided new funding for workers' compensation surveillance,

NIOSH Sponsored State Occupational Health and Safety Surveillance Program



Footnotes
*Date updated 2015
†26 Awards
‡Includes workers compensation surveillance awards

Fundamental Programs

Georgia
Iowa
Maryland
Minnesota
Mississippi
Montana
New Jersey
Tennessee
Texas
Wisconsin

Fundamental-Plus Programs

Colorado
Connecticut
Florida
Illinois
Louisiana
Nebraska
New Hampshire
North Carolina

Expanded Programs

California
Kentucky
Massachusetts
Michigan
New York
Oregon
Washington

Fatality Assessment & Control Evaluation

California
Kentucky
Massachusetts
Michigan
New York
Oregon
Washington

Respiratory Diseases Projects

California
Massachusetts
Michigan
New York
Washington

Other and Pesticides Projects

California‡
Massachusetts‡
Michigan
Washington

maintained AgFF funding to support forestry safety research, and continued support of the Mesothelioma National Tissue Bank. Additionally, NIOSH supported training programs through cooperative agreements including the Miner Safety and Health Training Program.

Unlike grants that are conducted independently of the sponsoring agency, cooperative agreements bring together the expertise of federal and nonfederal researchers to accomplish public health efforts that would not otherwise occur. In order for a cooperative agreement to be awarded, there must be a clear need for programmatic staff involvement during performance of a proposed project. An evaluation is made to determine that the cooperative agreement is of sufficient priority to warrant the commitment of staff resources required for a collaborative effort during the term of the cooperative agreement award.

1. State Surveillance Program

a. Overview

The state surveillance program supports the capacity development among states to conduct surveillance of occupational injuries, illnesses, and fatalities, and it helps expand the role of states in conducting in-depth surveillance and follow-up investigations and interventions. These local state-based skills and abilities help meet the NIOSH mandate to ensure a safe workplace. See the State Surveillance Portfolio Annual Performance Reports for more information on these state-based initiatives.

b. Public Health Relevance

The NIOSH surveillance research program acknowledges and values the contribution of state programs in occupational safety and health surveillance. NIOSH provides financial and technical assistance to state health and labor agencies to develop and expand capacity for programs dealing with occupational health surveillance. The extramural surveillance portfolio comprises 26 state recipients, encompassing 49 projects, for addressing work-related morbidity and mortality, exposures and hazards, and special worker populations of interest. These programs' overall goals include using and disseminating occupational health surveillance data for identifying the incidence and prevalence of occupational injuries, illnesses, and fatalities; identifying occupational health surveillance trends, research opportunities, emerging issues, and high-risk worker populations; creating and disseminating targeted educational and prevention materials for optimizing their uptake or adaptation for protecting workers; and conducting outreach and engaging partners in public health and safety for advancement of "data into action."

c. Selected Program Highlights FY2015

Cleaning for Asthma-Safer Schools Reduces Asthma Risk for Students and Staff

A paradox exists for cleaning many of the nation's schools. While clearing schools of contaminants and microbes to keep students and staff healthy, cleaning may expose them to harmful chemicals that are in products. Some ingredients in conventional cleaning products like floor strippers, disinfectant wipes, and bathroom cleaners, or

chemicals like ammonia and bleach pose risks for school building occupants that are avoidable. In California, an estimated 40% of adults suffering from asthma report their jobs either caused or aggravated their illness, and the state's Work-Related Asthma Prevention Program (WRAPP) maintains that 11% of work-related asthma cases in its surveillance database are related to cleaning products. Of these cases, nearly 20% had jobs that involved cleaning such as custodians. WRAPP identified the remaining 80% as bystanders who worked near areas where cleaning occurred. These cases included many school workers. In response to this problem, WRAPP developed "Healthy Cleaning & Asthma-Safer Schools: A How-To Guide," to help K–12 school districts transition to asthma-safer cleaning products and practices. The guide explains to school administrators, facility managers, and other school advocates how to switch to asthma-safer cleaning in simple, manageable steps. It also includes ready-to-use tools and resources related to finding safer products, and forms to assist districts in making changes and promoting safer cleaning practices within schools. WRAPP pilot tested the guide with 10 volunteer school districts across California and estimated that exposure to unhealthy cleaning chemicals was reduced for hundreds of school staff members and over 143,000 students. So far, the guide has been distributed to over 2,100 individuals.

Details
http://www.cdph.ca.gov/programs/ohsep/Pages/ClassGuide.aspx

Company Changes Subcontractor Policy Following FACE Report

Following a workplace death on a construction site, a Kentucky Fatality Assessment and Control Evaluation (FACE) Program report recommended that general contractors coordinate and stagger multiple subcontractors' work. The recommendation is aimed at avoiding schedule conflicts and minimizing associated problems such as disputes, occupational hazards, and obstructions on the job for construction workers. As a result of the FACE report, the construction contractor mentioned in the document implemented new policies requiring staggered work schedules for subcontractors and requiring workers to wear fall protection equipment at all times. Other construction companies have responded favorably to this change and indicate plans to implement the same policies.

Details
http://www.mc.uky.edu/kiprc/projects/KOSHS/face/data/Reports/13KY042-TB3.pdf
(A Metal Fabrication and Finishing Foreman Dies after 25 Foot Fall at a Commercial Building Site, Incident Number: 13KY042)

Ensuring Safer Products through the Development of Third-Party Certified Standards

To help employers, workers, and consumers find safer cleaning products and also influence how these products are created, the Work-Related Asthma Prevention Program assisted in developing UL ECOLOGO and Green Seal third-party certification standards. These standards define the attributes a product must have in order

to be certified. Products that have the ECOLOGO or Green Seal certification are scientifically proven to meet these rigorous, third-party environmental performance standards. Manufacturers are required to submit their products for third party certification review and are subject to audits to ensure that products comply with published standards. In earlier versions of the standards, products containing known asthma causing chemicals could receive certification. WRAPP aimed to change this through participating in the revision of certification standards so that products containing chemicals that trigger allergic type asthma will not be certified. The impact of the revised standards is wide-reaching because many policies and guidelines nationwide require the use of certified products. Eleven states currently have laws that either require or encourage the use of third-party certified cleaning products in schools. Additionally, the Leadership in Energy & Environmental Design (LEED) program, an environment-oriented building certification program operating under the US Green Building Council (USGBC), gives rating points towards its green building certification for use of Green Seal and US ECOLOGO certified products in facilities. LEED is used to rate nearly two million square feet daily. For developers, builders, and owners, this certification is commercially advantageous for attracting buyers, renters, and leasers who seek environmentally sustainable, cost-efficient business or residential space.

Pesticide Exposure Data Utilized By Federal and State Agencies

The Michigan Enhanced Program in Occupational Injury and Illness Surveillance (MIOSHA) focuses on three core functions in public health: collection and analysis of data, building partnerships to promote the goal of reducing occupational illness, and assuring efforts to prevent additional work-related illness. To increase its effectiveness and reach, the program highly collaborates with state agencies, numerous professional and trade groups, and medical professional societies in Michigan. During FY2015, one key outcome for MIOSHA is that the Michigan Department of Agriculture and Rural Development (MDARD) and Michigan State University used pesticide exposure stories during pesticide applicator trainings. These stories were initially featured in MDARD's Pesticide Advisory Committee quarterly reports. Additionally, the U.S. Environmental Protection Agency (EPA) is also utilizing MIOSHA data during its evaluation process of pesticide reregistration, which includes determining requirements for pesticide product labels.

Promising Results for Minimizing Silica Exposure for Florida Construction Workers

The Florida Occupational Health and Safety Program (OHSP) identifies the construction industry as a high priority industry. Construction surveillance data indicates high rates of morbidity and mortality, particularly among Hispanic workers. In particular, the Occupational Safety and Health Administration has identified silica as a National Emphasis Program Area for this industry. To address this issue, OHSP collaborated with the University of Miami for a pilot intervention focused on crystalline silica dust exposure among South Florida construction workers.

The study investigated whether a toolbox talk accompanied by an air monitoring demonstration was more effective than a toolbox talk alone in enhancing safety knowledge and influencing behavior change among construction workers, which includes increased use of personal protective equipment. Toolbox talks are informal educational discussions on safety topics and are a standard component of construction worksite safety. However, adult learning theories suggest behavior change is aided by a combination of educational methods and interactive strategies. This project demonstrated that workers exposed to both the toolbox talk and air sampling had improved knowledge and behavior change compared to the control group receiving only the toolbox talk. In particular, this experimental group demonstrated greater use of the personal protective equipment (N95 particulate respirator mask) provided to all research participants following the intervention. Because the combination of air monitoring demonstrations and toolbox talk illustrates promising results, OHSP is considering integrating this approach into future worksite-based educational interventions with construction workers. OHSP hopes that this project will lead to funding opportunities for larger studies assessing the impact of the toolbox talk with a demonstration.

Redesign of Handicapped Accessible Accelerator Pedal for Personal Vehicles

An automobile product maker redesigned its handicapped-accessible gas pedal based on a Kentucky Fatality Assessment and Control Evaluation (FACE) Program report, published after a vehicle struck and killed a car dealership employee. In 2015, Veigal North America LLC Mobility Products & Design redesigned its Left Foot Gas Pedal Model 3545. The new design adds a key to the vehicle's steering column that disengages the handicapped accessible foot pedal, eliminating the removal of these pedals by hand when vehicles are serviced. Additionally, the dealership mentioned in the FACE report now requires the removal of all handicapped equipment before servicing vehicles and has removed desks from the service area for overall injury prevention for auto technicians and others.

Details
https://www.cdc.gov/niosh/face/pdfs/14KY001.pdf
(Auto Technician Mistakes Handicapped Accessible Accelerator Pedal for Brake Pedal and Fatally Pins Co-worker, Incident Number: 14KY001)

Sudden Spike in Pesticide-Related Illness Triggers Public Health Actions to Prevent Drift

Despite efforts to prevent agricultural pesticide drift, surveillance identified an upward trend in illnesses in Washington State, resulting from drift of pesticides applied to crops. The issue started in 2010 with a spike in incidences occurring in 2014. Fifteen events involving more than 50 people were reported in May 2014, which is typical according to the Washington State Department of Health (DOH). However, by the end of 2014, these figures rose to 22 separate drift events, resulting in acute illness in 129 people, the majority of whom (80%) were farmworkers. In response to this problem, DOH Pesticide Illness Surveillance and Prevention

(PISP) team and agency leaders met with partners in the agricultural industry, labor advocates, and agencies that license pesticide applicators. An analysis of the drift data and work sessions between PISP and varied partners led to the identification of root causes. These included an ineffective alert system for pesticide drift and the inability to predict shifting weather conditions to impact drift. PISP served in an advisory capacity on the Washington State Department of Employment Securities Agency Farmworker Advisory Committee. PISP illness data related to pesticide drift supported policy recommendations for stronger protections for farm workers and bystanders. These include stronger notification requirements and the need to extend no spray zones between pesticide application and workers or other bystanders. The committee included a section with prevention guidance for drift events in its final report to the Washington State Legislature. In 2015, Washington State legislators asked PISP to participate in a work session of the House Health Care and Wellness Committee on pesticide drift. Legislators are communicating with DOH to discuss proposed legislation to reduce drift and improve pesticide use reporting. PISP is also collaborating with researchers at the University of Washington to better understand the impact of weather conditions on pesticide drift and has initiated research with these scientists. PISP presented case studies in Spanish and English to large audiences of farmworkers and farm managers at the Governor's Agricultural Safety Day workshops. Since PISP's efforts to minimize this problem, pesticide drift events have significantly declined. The figures below show the number of events during spring and summer 2015 when compared to the previous year. Weather patterns and employment statistics during this time period are similar to the previous year.

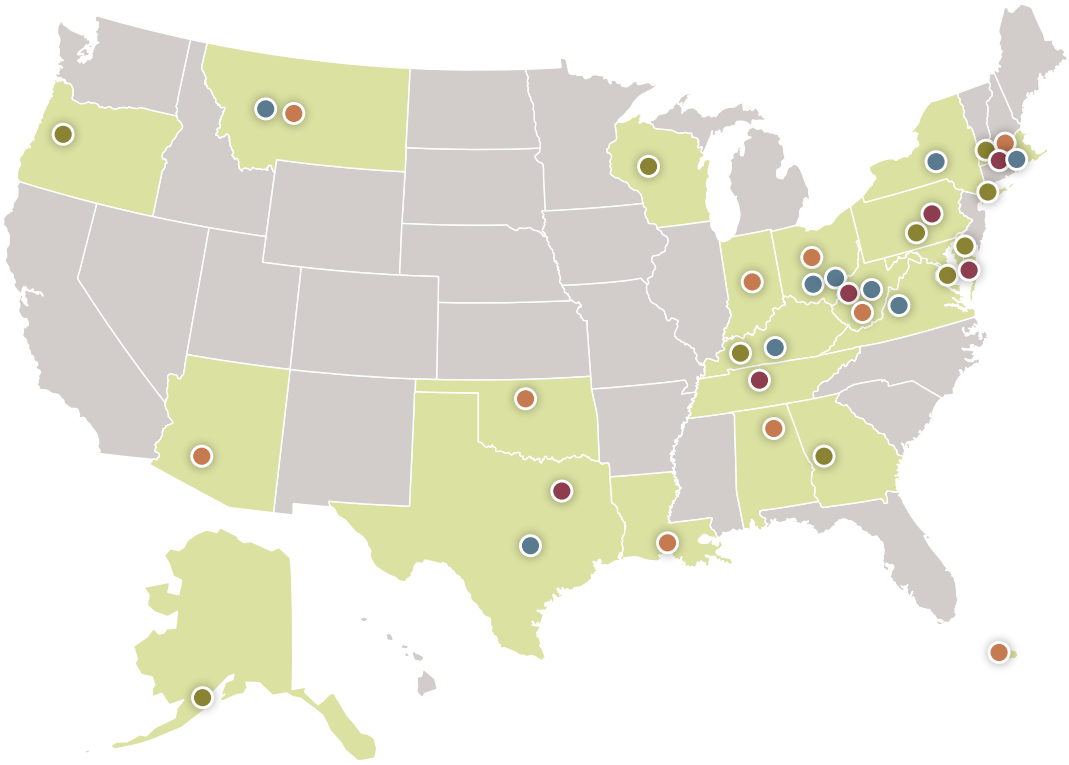
Dates	Number Events	Number Illness Cases (People)
March–June 2014	19	59
March–June 2015	6	20

2. Training Project Grants

a. Overview

NIOSH supports professional training in occupational safety and health in single disciplines through Training Project Grants (TPGs). The majority of TPGs are academic training programs that support undergraduate and graduate training. These programs complement the national network of graduate training provided by ERCs, and they are located throughout the United States. In addition to TPGs for traditional degree training programs, NIOSH also supports TPGs that address the unique training needs of specialty groups. These include the Association of Occupational and Environmental Clinics (AOEC) Occupational Health Internship Program (OHIP). This program provides specialty training and increases diversity among the next generation of occupational health professionals by recruiting and mentoring students from minority and immigrant backgrounds including underrepresented minorities. The Alaska Marine Safety Education Association has a TPG that expands the network of port-based fishing safety instructors in Alaska and the United States through train-the-trainer curriculum

NIOSH Training Project Grants by Discipline



Occupational Safety	Industrial Hygiene	Allied Occupational Safety & Health	Occupational Medicine
MA/Lowell	Arizona	Alaska Marine	Meharry
Montana Tech	MA/Lowell	Association of Occupational and Environmental Clinics	Pennsylvania
Murray State	Montana Tech	Connecticut	Texas/Tyler
Ohio State	North Alabama	Emory	West Virginia
Ohio University	Oklahoma	International Association of Fire Fighters	Yale
SUNY/Buffalo	Puerto Rico	MA/Lowell	
Texas A&M	Purdue	Millersville	
Virginia Tech	Toledo	Portland State	
West Virginia	Tulane	Wisconsin/Stout	
	West Virginia	Western Kentucky	

designed for the unique needs of the commercial fishing industry. NIOSH also provides funding for a unique TPG, which is the Emergency Responder Training Program through the International Association of Fire Fighters (IAFF). Additional information about this program is discussed later in this report.

b. Public Health Relevance

TPGs are one of the principal means for NIOSH to provide the nation with an adequate supply of qualified professionals to carry out the Occupational Health and Safety Act of 1970. The nation's workforce is diverse, and TPGs help train in specific disciplines where an identified need is being met. The graduates of TPGs serve a vital role in protecting and promoting the health and safety of the nation's workforce, aligning with the goals of Healthy People 2020—to prevent diseases, injuries, illnesses, and fatalities that are due to working conditions. Occupational safety and health training is essential to eliminate these hazards and make the workplace safer and healthier for all workers. TPGs are also important resources on occupational safety and health issues for business, labor, government, and the public.

c. Selected Program Highlights FY2015

Training Project Grant Trainees, Graduates and Employment by Discipline

In academic year 2014–2015, 148 trainees graduated from the TPG academic training programs with specialized training in industrial hygiene, occupational safety, occupational medicine, and allied disciplines in occupational safety and health. Allied disciplines included occupational health psychology, risk management, occupational ergonomics and engineering, environmental health, and occupational epidemiology.

Training project grant trainees, graduates and employment by discipline, FY2015

Program Area	Trainees	Graduates	Employed in occupational safety and health field or seeking advanced training (%)
Industrial Hygiene	174	45	44 (98)
Occupational Safety	117	57	49 (86)
Occupational Medicine	31	13	13 (100)
Allied Disciplines	74	33	30 (91)
Total	396	148	136 (92)

Preparing Safety Practitioners in Diverse Topics of Occupational Safety and Health

The TPG at Ohio University addresses the shortage of well-trained safety practitioners in southeastern Ohio and the Ohio River Valley. A unique approach at the Ohio University TPG is student participation in two internships – one with the university's Department of Safety during their first year in the program, and one between year one and year two of their studies. Students complete research on diverse topics that are within the scope of the expertise of the faculty and the students' interest. Examples include injuries in the automotive repair sector in Ohio (with an emphasis on older workers), safety management practices at regional campuses, ergonomic interventions for Ohio University offices and the development of leading indicators. Currently, students are working on topics related to advanced data analysis methods for injury analysis, fall safety, the use of lean methodology to improve the procurement of ergonomic office equipment, ergonomic analysis of restroom design and analysis of software for sit/stand workstations.

The Global Reach of Trainees

Graduates from the TPG at Portland State are currently employed around the globe including in Turkey and the Czech Republic (Prague). Portland State's TPG is a graduate training program in Occupational Health Psychology (OHP). OHP is an emerging field and involves the application of psychological principles to improving the quality of work-life and promoting the safety, health, and well-being of people at work. OHP is a rapidly expanding interdisciplinary field focusing on the promotion, development, and evaluation of workplace health and safety-related initiatives. It integrates individual approaches to safety and health as well as organizational approaches and holds many of the same concepts as the NIOSH TWH approach to integrating health promotion and health protection. OHP researchers and practitioners draw from the domains of public health, preventive medicine, nursing, industrial engineering, law, epidemiology, and psychology to develop sound theory and practice for protecting and promoting the safety, health, and well-being of individuals in the workplace.

3. Emergency Responder Training Program

a. Overview

NIOSH funds a unique TPG in Emergency Responder Training Program through the International Association of Fire Fighters (IAFF). The IAFF's mission through this program is to educate emergency responders about strategies to safeguard their health and safety, and reduce occupational injuries, and fatalities related to emergency response, so they can better protect the communities they serve. The IAFF has had a long working relationship with NIOSH and currently delivers training to all disciplines in emergency response: fire fighters, emergency medical personnel, law enforcement, and public health. The IAFF's proven training record strongly emphasizes occupational safety and health as part of a comprehensive first responder training plan. IAFF's training seeks to

fundamentally change knowledge, attitude ,and behaviors, causing responders to adopt a safer approach to emergency response throughout their career. Training is conducted across the United States and U.S. territories.

b. Public Health Relevance

This federally funded training program provides an excellent model of a delivery system for training first responders. Using a cadre of instructors who are both certified fire service instructors and hazardous materials (HazMat) responders, the IAFF offers real-world training in HazMat response that few institutions can match. Furthermore, because the IAFF brings its training directly to the students in their own communities, the IAFF is able to tailor its presentations to address the unique concerns and challenges facing local responders. IAFF training is a proven resource that directly affects decisions made in real-world scenarios fire fighters experience every day, and they have developed training partnerships with thousands of fire departments throughout the United States.

c. Selected Program Highlight FY2015

The IAFF exceeded its projected goals for training in FY2015 of 72 classes and 1,440 students by delivering a total of 90 classes to 2,107 students, with 44,560 contact hours.

Emergency Responder Training Classes, FY2015

Class Title	Duration	# of Classes	# of Students	# of Contact Hours
Confined Space Operations	16 hours	8	225	3,600
Confined Space Operations	24 hours	1	15	360
Illicit Drug Labs	8 hours	12	183	1,464
Emergency Response to Terrorism: Operations	16 hours	6	160	2,560
First Responder Operations	24 hours	63	1,524	36,576

4. Miner Safety and Health Training Program

a. Overview

Despite many technological and work environment advances, mining remains one of the most challenging and demanding occupations in the United States. Because of the many challenges in the mining industry, the focus areas for mining training must encompass a wide range of hazards and risks.

The mining community in the eastern United States is served by the Mine Safety and Health Administration (MSHA) Training Academy in Beckley, West Virginia. The training program in West Virginia is not easily accessible to miners in the Western United States, and certain aspects of western mining operations are not pertinent to operations in the east. To increase access to training and to address gaps related to western mining

operations, NIOSH has supported miner safety and health training in the Western United States since 1999. For 2015, three programs were funded: the Colorado School of Mines, the University of Arizona, and the University of Texas at Arlington.

This training provides an integrated approach to reducing injuries to miners and other workers in mining operations and to translate research into workplace practices that improve mining safety, improve the safety and health of miners, and enhance the safety and health of other workers involved in mining operations.

Major objectives are to provide a training program that (1) addresses the training needs of miners in the Western United States, (2) develops and delivers training to miners in the Western United States, (3) provides qualified instructors and faculty, (4) evaluates training effectiveness and impact on reducing injuries and illnesses to miners, and (5) coordinates with existing training programs, such as those offered by MSHA and MSHA-funded state programs.

b. Public Health Relevance

The Miner Safety and Health Training Program provides critical safety and health training to protect workers in one of the most dangerous industry sectors in the United States. This program contributes to this overall goal by taking the following actions:

- Expanding the mission of NIOSH in protecting and promoting the health of mine workers. The trainings have improved work practices, reduced work-related injury and illness, and increased the understanding of safety and health practices in Western mine worksites.
- Increasing the safety focus, total health awareness, and leadership competency of miners, frontline supervisors, superintendents, and managers representing operations throughout the United States, spanning all major commodity sectors in surface and underground mining, as well as contractors.
- Directing the focus of mine-rescue training toward learning actual rescue skills rather than mine rescue contest rules, resulting in team members being better prepared to respond to all types of emergencies.

This program fills an important regional need by providing occupational safety and health training, mine emergency response and rescue training, and needs-based education to individuals and companies engaged in mining and exploration activities throughout the western United States. The program is particularly critical for underserved populations working on mine sites, including contractors, suppliers, consultants, equipment manufacturers, and small mine operators.

The program designs and implements active learning strategies for mine safety training and has trained trainers across all commodity sectors throughout the Western United States on how to improve safety training. These activities increase capacity and improve the transfer of best practices to the workplace.

c. Selected Program Highlight FY2015

CSM Releases New Version of MSHA Required Training

The Colorado School of Mines (CSM) developed and implemented a new training designed to support MSHA training requirements, as defined under 30 CFR Part 48 for new miner and refresher training at surface and underground mines. This Part 48 training is intended to supplement current training activities sponsored through the Colorado MSHA State Grants program. The training is unique in multiple ways from other Part 48 courses that are offered. It focuses on meeting the needs of underserved populations working on mine sites, including contractors, suppliers, consultants, equipment manufactures, and small mine operators. Next, CSM strategically utilizes a group of technical experts as instructors for both the Annual Refresher Training and New Miner Training for surface and underground operations. Because of their experience, these instructors present information in a context that makes it understandable and directly applicable to miners. The New Miner Training course also consists of 24 hours of instruction rather than the 20 hours offered by other training providers. Because MSHA approved 24 hours of instruction for the training, trainees are not required to complete an additional four hours of instruction at a surface mine as with other trainings. This is important because many individuals attending the CSM training are contractors, and it is often difficult for them to complete an additional four hours of training. The most significant aspect of the New Miner Training is that trainees spend a half day underground at the CSM Edgar Experimental mine learning safety practices. Within the Western United States, CSM is one of the few institutions, other than mine operators, that integrates training at an underground mine as part of its New Miner Training course. In FY2015, CSM offered 28 Part 48 training courses to 283 participants, and trainees rated them as excellent or very good. The technical expertise and variety of training instructors were considered significant strengths. Across the courses, 39% to 59% of trainees indicated that their new knowledge would be used to train others.

Higher Level Trainer Curriculum Widely Disseminated and Adopted in Mining Sector

Lecture-based instruction that utilizes tools such as Microsoft PowerPoint has been commonly used for years for mining industry training. To improve skill and knowledge transfer during these safety and health trainings, the University of Arizona developed the Higher Level Trainer, which is a scripted active learning training, intended to enhance lecture-based instruction. This approach has proven more effective in adult-learning settings than lectured-based trainings. A key component of the curriculum is that it includes interchangeable methods between lecture and interactive exercises. The Higher Level Trainer course materials are now published as a *Mine Safety Training Handbook,* which the University of Arizona disseminates at every Higher Level Trainer session for trainers. During this event, trainers learn how to gauge their own audience and utilize the handbook to revise their current

training methods, based on audience needs. The handbook provides trainers with a clear lesson plan that directs them, using a sequence of steps and prompting points. Trainers can adapt all of the activities in the handbook to work for individuals, pairs, small groups or large group trainings. The Higher Level Trainer approach is also incorporated into the University of Arizona's MSHA New Miner Training, Annual Refresher Training, and Experienced Miner courses. Several major American mining companies have implemented the Higher Level Trainer curriculum. These businesses include Freeport McMoRan, Luminant, McCraren Safety, Resolution Copper, Vulcan Materials, BHP Billiton, Coeur D'Alene, Bridger Coal, and Skyline Coal. Evaluations of the training demonstrate that it is effective, resulting in a better-prepared miner. This approach to training elicited positive responses from instructors and trainees alike, with comments such as "Wow, it didn't feel like that was 8 hours."

Society of Mining Invites UTA to Present on Newly Developed Leadership Development Courses for 1st Line Supervisors

One of the goals for the University of Texas at Arlington (UTA) is to increase leadership development for first line supervisors in mining operations in order to improve safety and health in western mines. During FY2015, UTA created the "Leadership Development Course for 1st Line Supervisors" – a 2-day course delivered onsite and at no cost to miners in the Western United States, especially those in underserved areas. The training supports frontline mining supervisors in developing leadership skills so that they are better able to influence employees to work safely and contribute towards a positive organizational culture. The course consists of 15 targeted modules that address the topics areas of self-awareness, effective interaction with others and examination of the work environment with a focus on enhancing leadership effectiveness. The course was pilot tested with a group of primarily frontline supervisors from four different mines in Utah. UTA received positive feedback from these leaders with a common theme that they wanted even more information. The Society of Mining invited UTA to present on the "Leadership Development Course for 1st Line Supervisors" during its Metallurgy and Exploration (SME) meeting in February 2015.

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